

BLUMEA

TIJDSCHRIFT VOOR DE
SYSTEMATIEK EN DE
GEOGRAFIE DER PLANTEN

(A JOURNAL OF PLANT-TAXONOMY
AND PLANT-GEOGRAPHY)

UITGEGEVEN DOOR HET RIJKSHERBARIUM TE LEIDEN
(PUBLISHED BY THE RIJKSHERBARIUM, LEIDEN, HOLLAND)

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B L U M E A

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en de Geografie der Planten.

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Redacteur:

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B L U M E A

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Rijksherbarium, LEIDEN, Nederland.

Directeur: Prof. Dr H. J. LAM (Phan.: Burserae., Sapotae., Verbenae.).

Conservator: Dr J. TH. HENRARD (Phan.: Gramineae).

Hoofdassistent: W. J. LÜTJEHARMS (Fungi).

Assistent: Dr S. J. VAN OOSTSTROOM (Phan.: Convolvulac.).

Wetenschappelijke hulpkracht: Mej. Dr J. TH. KOSTER (Algae; Phan.: Compositae).

Uitgegeven door het	}	Rijksherbarium,
Published by the	}	Leiden, Nederland.

VOORREDE.

„It is hoped that the actual value of this most important collection of historical material preserved in the Rijksherbarium is fully appreciated not only in Holland, but elsewhere, and that proper provision will be made for the amplification and study of these collections that in actual scientific value, with particular reference to Malaysia, are unparelled in any other single botanical institution of the world”.

(E. D. MERRILL in „Herdenkingsuitgave bij gelegenheid van de honderdjarige vestiging te Leiden [van het Rijksherbarium]
— Med. van 's Rijks Herbarium No. 65, 1931, 3).

Vierentwintig jaren zijn verlopen sinds de instelling, die toen „'s Rijks Herbarium” heette, begon met de uitgave van een reeks publicaties onder den titel van „Mededeelingen van 's Rijks Herbarium Leiden”. Juist 70 nummers zijn verschenen tusschen 1910 en 1933, met inbegrip van het laatstgenoemde jaar, de meeste daarvan onder het directoraat van Dr J. W. C. GOETHART. Het is hier zeker de plaats Dr GOETHART dank te brengen voor alles wat hij in die jaren voor deze uitgave van het Rijksherbarium heeft gedaan.

Nadat ondergeteekende op 2 October 1933 het directoraat van het Rijksherbarium uit de handen van den waarnemenden directeur, Dr W. A. GODDIJN, had overgenomen, kon een begin worden gemaakt met de uitvoering van enkele plannen, die in verband met zijn ervaring, in de tropen opgedaan, eenig perspectief voor de toekomst schenen te beloven. Zoo lag het, op grond van de zooeven genoemde ervaring voor de hand, dat de werkwijze van het Rijksherbarium zich meer in de richting van de Nederlandsch-Indische flora zou gaan bewegen, dan in de laatste decennien mogelijk was geweest. Verwezenlijking van deze gedachte is mogelijk door samenwerking met het Herbarium en Museum van Systematische Botanie van 's Lands Plantentuin te Buitenzorg, waarmede ik reeds voor mijn vertrek uit Indië in dien geest overeenstemming mocht bereiken.

Een tweede punt van overweging was het vormen van een inniger contact met de Rijksuniversiteit te Leiden, met welks Herbarium het Rijksherbarium sinds 1832 verbonden is geweest. Dit contact was veelal van weinig beteekenis en de details van zijn toekomstige ontwikkeling

zullen nauwgezette zorg vereischen teneinde te vermijden, dat de archief-waarde van het Rijksherbarium schade lijdt. Ik meen, dat het mogelijk is een inniger contact te bewerkstelligen zonder dat ten aanzien van het laatstgenoemde punt zoodanig risico wordt geloopt, dat het tegen de voordeelen niet ruimschoots zou opwegen; en niet alleen mogelijk, maar ook wenschelijk, want het kan tweeërlei belangen bevorderen: ten eerste kunnen de in het Rijksherbarium aanwezige schatten zoowel meer intensief als meer extensief tot hun recht worden gebracht, en ten tweede kan getracht worden het aantal medewerkers aan het gestelde doel niet onbelangrijk te vergrooten.

Bij het uitwerken van deze plannen kwam vanzelf een derde punt naar voren, zij het een punt van ondergeschikt belang. De „Mededeelingen van 's Rijks Herbarium” zijn een historisch gegroeide reeks publicaties, die, doordat zij van den aanvang af in vrijwel onveranderden vorm zijn verschenen, heden ten dage niet geheel modern meer zijn. Was er natuurlijk onder mijn voorganger geen directe aanleiding in die traditie eenige verandering te brengen, nu komt het mij voor, dat, zoo ooit, de verandering van directoraat en werkrichting ook het juiste oogenblik is, om de publicaties van het Rijksherbarium, waarvan de inhoud zich onder den invloed van de genoemde veranderingen allicht eenigszins zou wijzigen, ook naar den uiterlijken vorm te herscheppen.

Daarom werd behalve een handzamer formaat ook een modernere letter gekozen, terwijl de artikelen niet meer afzonderlijk zullen worden genummerd en gepagineerd. Het tijdschrift zal evenwel ook in zijn nieuwen vorm, evenals de „Mededeelingen” op ongeregelde tijden verschijnen. Dat ook de naam is veranderd, is natuurlijk een weinig belangrijke bijkomstigheid. Een van de belangrijkste overwegingen, dat daartoe gekozen is de naam BLUMEA (naar den eersten directeur van het Rijksherbarium, Prof. Dr C. L. BLUME¹), directeur van 1829—1862) was de wensch, dat hij kort²) en karakteristiek zou zijn.

Het is mijn hartelijke wensch, dat „BLUMEA” zal uitgroeien tot een algemeen Nederlandsch tijdschrift voor plantensystematiek en plantengeografie. Bij den huidige stand van de middelen van het Rijksherbarium echter is helaas voorshands eenige restrictie geboden. Tenzij meer middelen voor de uitgave worden gevonden, moet de voorrang worden verleend aan artikelen op plantensystematisch en planten-geografisch gebied, die

1) Het vignet is van de vaardige hand van Dr W. A. GODDIJN.

2) Cf. MERRILL E. D., One-name periodicals. — *Brittonia* 1, 1931, 1.

1. afkomstig zijn van: a. vaste, b. tijdelijke werkkrachten aan het Rijksherbarium;
2. zijn bewerkt op grond van of gedeeltelijk op grond van materiaal, dat het eigendom is van het Rijksherbarium;
3. de flora (systematiek, floristiek) of de vegetatie (oecologie) van: a. den Indischen Archipel, b. de dien Archipel omgevende landen tot onderwerp hebben.

Zoolang deze restricties echter niet toegepast behoeven te worden, zal *BLUMEA* eveneens openstaan voor andere artikelen op haar gebied. De Directeur van het Rijksherbarium zal als verantwoordelijk redacteur gaarne met toekomstige inzenders in onderhandeling treden. Hij behoudt zich evenwel het recht voor artikelen te weigeren of aan inzenders bepaalde voorstellen tot inkrimping van een artikel of vermindering van het aantal illustraties te doen, wanneer de omstandigheden hem daartoe zouden nopen.

Het is mij een groot genoegen het eerste deel van „*BLUMEA*” te kunnen openen met bijdragen niet alleen van alle leden van den wetenschappelijken staf, maar ook van zijn officieuzen medewerker Dr J. J. SMITH, vroeger Hoofd van het Herbarium te Buitenzorg, van Dr D. F. VAN SLOOTEN, tegenwoordig chef van die instelling, van mijn collega te Groningen, Prof. Dr B. H. DANSER, van mijn collega voor de algemeene plantkunde te Leiden, Prof. Dr L. G. M. BAAS BECKING en een zijner medewerksters, en ten slotte van den welbekenden bryoloog FR. VERDOORN. In bewerking is voorts een bijdrage van de hand van mijn ambtsvoorganger, Dr J. W. C. GOETHART, die voor dit nummer niet tijdig gereed kon zijn, en in een volgend nummer zal worden opgenomen. Ook zijn medewerking stel ik op hoogen prijs.

Moge „*BLUMEA*” het zijne bijdragen tot de beoefening van die takken van de botanie, waartoe het Rijksherbarium zoo ruimschoots het materiaal bezit en moge, in het bijzonder, in overeenstemming met het hierboven gestelde motto, de intensievere bestudeering van de flora van Nederlandsch-Indië, door samenwerking van velen het binnen afzienbaren tijd mogelijk maken onze kennis te gieten in den overzichtelijken vorm eener flora; Nederlandsch-Indië is in dat opzicht bij welhaast alle buurkoloniën en zelfs bij de zusterkolonie Suriname, ten achter.

EDITORIAL.

Twenty-four years have elapsed since the Institution, then called „'s Rijks Herbarium'', started a series of papers entitled „Mededeelingen van 's Rijks Herbarium, Leiden''. Exactly 70 numbers have been issued between 1910 and 1933 inclusive, most of them under the directorate of Dr J. W. C. GOETHART, to whom many thanks are due for his arduous work and his many cares in favour of these publications.

After the undersigned, on October 2nd, 1933, had taken over the directorate of the Rijksherbarium from the acting director, Dr W. A. GODDLIN, he could start realizing some projects which, in relation to his tropical experience, seemed more or less promising. First of all it was obvious that the Rijksherbarium should, to a greater degree than had been possible during the last decennia, contribute to the investigation of the flora of the Netherlands Indies. Effectuating this idea seems possible by a closer collaboration with the Herbarium of the Botanical Gardens of Buitenzorg, Java, with whose officers it was my privilege to come to an agreement before I left the colony. Another point to be considered was the establishment of a closer contact with the State University at Leiden, the herbarium of which has been united with the Rijksherbarium since 1832. This contact has been rather loose in various periods of the existence of the Rijksherbarium and in developing it, the details will have to be carefully studied and sounded, lest the archive value of the collection should be decreased. Without taking any risk as to this point, which cannot be fully compensated by the advantages, it is thought that a closer contact is both possible and desirable, as it may further two important interests: in the first place it is intended to exploit and to peruse both more intensively and more extensively the treasures of this Herbarium, and secondly an attempt will be made to increase the number of students in the field of investigation that is allotted to the institution.

During the preparations of these plans a third point has arisen of its own, demanding, though of little intrinsic importance, its individual solution. The „Mededeelingen van 's Rijks Herbarium'', being a historically grown series of publications, issued in practically the same form ever since the first number, can at present not be considered as a modern journal. As a matter of fact there was no particular reason why my predecessor should have made any alteration in the tradition.

However, it seems to me that, if ever, the time of changing the directorate and the way of working of the institution — which will probably also affect the contents of the journal —, must also be the right moment to reshape its exterior appearance. Therefore, next to a more standardized size, also a more modern letter type has been chosen; moreover, the various papers will no longer be separately numbered and paged. Also in its new form, however, the journal will be issued at irregular intervals. That its name has been changed too is, of course, a point of minor importance. One of the arguments that this name has been chosen to be „BLUMEA” (after the first director, Prof. Dr C. L. BLUME¹), director from 1829—1862), was that it should be short²) and characteristic.

It is very much hoped that „BLUMEA” will develop into a general Dutch journal of plant taxonomy and plant geography. On account of the present state of the funds available to the Rijksherbarium, however, it is regretted that, for the time being, some restrictions are necessary. Unless more ample funds will be found for its publication, precedence must be given to those papers that

1. are written by a. permanent, b. temporary collaborators of the Rijksherbarium;
2. have made use of materials belonging, wholly or in part, to the Rijksherbarium;
3. are concerned with the flora (taxonomy, geography) or the vegetation (ecology) of a. the Malay Archipelago, b. countries surrounding that Archipelago.

As far as allowed by these restrictions, „BLUMEA” will gladly receive other papers of a similar nature. The director of the Rijksherbarium will be its responsible editor and will be glad to correspond with future contributors; however, he reserves to himself the right to refuse papers or to make such proposals concerning eventual alterations (e. g. as to the illustration or the extent of a paper) as may seem suitable or necessary in the circumstances.

I deem it a privilege to open the first number of „BLUMEA” with papers not only by all staff members of the Rijksherbarium, but by its unofficial collaborator Dr J. J. SMITH, formerly keeper of the

1) The vignette is by the able hand of Dr W. A. GODDIJN.

2) Cf. MERRILL E. D., One-name periodicals. — *Brittonia* 1, 1931, 1.

Buitenzorg Herbarium, by Dr D. F. VAN SLOOTEN, present keeper of that institution, by my colleague at Groningen, Prof. Dr B. H. DANSER and by my colleague for general botany at Leiden, Prof. Dr L. G. M. BAAS BECKING and one of his staff members, and finally by our well-known bryologist FR. VERDOORN. I am equally glad to announce a contribution by my predecessor Dr J. W. C. GOETHART, which could not be finished in time for the present issue but will appear in the next one; his collaboration to „Blumea” is also very much appreciated.

May „Blumea” do its part towards the development of those fields of botany, to which the Rijksherbarium may so amply yield the materials and many, more particularly, in accordance to the quotation which is heading the Dutch version of the present lines, the investigation of the flora of the Netherlands Indies, at no distant date make it possible to compile our knowledge into the comprehensive form of a flora. The Netherlands Indies has, in this respect, something to learn from almost all neighbouring colonies and even from its sister colony Surinam.

Leiden, May 1934.

H. J. LAM.

ZUM GELEIT

von

D. F. VAN SLOOTEN,

Leiter des Herbariums des Botanischen Gartens zu Buitenzorg (Java).

Anlässlich der Centenarsfeier des „Rijksherbarium“ zu Leiden im Jahre 1930 schrieb Prof. Dr L. DIELS in Berlin-Dahlem einen Beitrag, betitelt „Herbarien und Sammler“, für die „Herdenkingsuitgave“ der „Mededeelingen van 's Rijks Herbarium“ (No. 62—69, Leiden, 1931). In diesem Beitrag wurde Wert und Bestimmung von Herbarien und die Aufgabe des Sammlers gekennzeichnet. Durch das Sammeln ganzer Pflanzen und genauer Etikettierung können, so führte DIELS aus, die Sammler viel beitragen zur Vermehrung der botanischen Kenntnis, u. a. von den Verbreitungsgebieten der Pflanzen und der Pflanzenökologie. DIELS kommt zu dem Schluss: „Selbst in den alten Kulturländern liegen dankbare Aufgaben in dieser Richtung vor. Doch am grössten ist die Verantwortung der Anstalten, die ihre Arbeit in erster Linie auf die tropischen Floren wenden. Denn das Gesamtbild, das wir uns von der Pflanzenwelt machen, gewinnt seinen Umfang, seine Mannigfaltigkeit und viele besondere Farben aus den Floren der Tropen. Mit der fortschreitenden Vernichtung der ursprünglichen Zustände in den wärmeren Ländern droht dieses Bild zu verarmen und eintöniger zu werden, ehe wir noch wirklich seinen Reichtum begriffen haben“.

Java, das heutigentags grösstenteils Kulturland geworden ist, bestätigt die Wahrheit des zitierten Satzes überdeutlich. So sind, um ein spezielles Beispiel herauszugreifen, die Urwälder der Niederung, welche früher grosse Flächen bedeckten, bis auf kleine Resten *Opfer der Kultivierung* geworden, lange bevor man die ursprüngliche Vegetation in ihren Elementen gut kennen gelernt hatte. Möge die Entdeckung von Relikten heute auch interessant sein, vom pflanzengeographischen Standpunkt aus muss man sehr bedauern, dass die systematische Erforschung der Vegetation nicht vor der Vernichtung des Urzustandes zu gewisser Vollendung gebracht werden konnte.

Infolge dieser Tatsache ist dann auch die Kenntnis der Niederungswälder auf Java sehr beschränkt geblieben, und diese Lücke kann wohl

nicht mehr nachträglich ausgefüllt werden, wennauch Ausnahmen zu verzeichnen sind, wobei durch eine überraschende Feststellung ein Einblick gewonnen wird in ehemalige Verhältnisse. Ein Beispiel hierfür bietet die Auffindung eines kleinen Sumpfwaldes bei Tjitjadas, das nur 22.5 km in Luftlinie nordöstlich von Buitenzorg, ungefähr 100 m über See gelegen ist. Der Mitarbeiter des Herbariums in Buitenzorg Dr C. G. G. J. VAN STEENIS fand ¹⁾, dass dieser Sumpfwald eine Flora aufweist, welche aus Elementen besteht, die wir sonst nur fast ausschliesslich aus dem grossen Danau-Moor in Bantam (West-Java) kennen. Dieses grosse Moor hat z. T. noch einen ursprünglichen Charakter mit manchen endemischen Bestandteilen ²⁾. Es gehört zu den Ausnahmen, da die meisten javanischen Moorgebiete schon Kulturbeflüusst sind. Dieser Umstand ist mit Schuld an der beschränkten Kenntnis der ursprünglichen Sumpfwälder.

Ein zweites Beispiel beweist, dass für Java noch in zwölfter Stunde durch Sammler und Herbarium auch bezüglich der Flora *unangetasteter* Gebiete wissenschaftlich wertvolle Feststellungen gemacht werden können. Aus Anlass der Auffindung von *Primula imperialis*, die hier bisher nur von den Bergen Pangrango (West-Java) und Yang (Ost-Java) bekannt war, auf dem Papandajan (West-Java) auf einer Höhe von ca. 2300 m, hat VAN STEENIS die weiten Grasflächen dieses Berges einer genauen Durchforschung unterzogen ³⁾. Dabei hat er nicht weniger als 25 Pflanzenarten — darunter drei für die Bergflora Javas unbekannte — gefunden, die nach bisheriger Auffassung nur in Ost- und Mitten-Java vorkommen sollten. Dadurch haben die früheren hypothetischen Grenzen zwischen West- und Ost-Javanische Floren viel von ihrer Schärfe verloren.

Im starken Gegensatz zu Java sind die meisten anderen Inseln Niederländisch-Indiens noch viel ursprünglicherer Natur. Das gilt z. B. von Sumatra. Durch den Umstand, dass der „Prodomus Florae Sumatranæ“ MIQUELS ⁴⁾ veraltet ist und trotz vieler Einzelpublikationen

1) „Het moerasboschje bij Tjitjadas, Res. Batavia“. De Tropische Natuur XXIII, 1934.

2) Eine Uebersicht über den Charakter des Danau-Moores, das seit 1921 zum Naturmonument erklärt wurde, gab Dr F. H. ENDERT in „Tectona“ XXV, 1932.

3) „Eenige belangrijke plantengeographische vondsten op den Papandajan“. De Tropische Natuur XIX, 1930, p. 73—91; XXI, 1931, p. 101—108.

4) Flora Indiae Batavae. Supplementum I, 1860—61.

eine neuere übersichtliche Flora dieser botanisch so wichtigen Insel ¹⁾ fehlt, wird es so sehr wünschenswert, dass wir mehr Zusammenfassendes erfahren, bevor die schon eingeleitete Kultivierung auch hier Zustände geschaffen hat, wie sie heute auf Java gegeben sind.

Unter den gegebenen Umständen ist es ausserordentlich begrüßenswert, dass der neue Leiter des „Rijksherbarium“ zu Leiden auch dieses Institut tatkräftig in den Dienst der Erforschung von Indiens Flora stellen will. Ein Mittel hierzu wird die neue Zeitschrift für Systematik und Geographie der Pflanzen: „BLUMEA“ sein, die heute in die wissenschaftliche Welt eintritt! Sie kann zu einer sehr wertvollen Ergänzung des „BULLETIN DU JARDIN BOTANIQUE DE BUTTENZORG“ werden.

Da eine zusammenfassende „Flora van Nederlandsch-Indië“ sehr viel Arbeitszeit und Mittel erfordert und dies auch für die monographische Bearbeitung der Familien, worauf im Bulletin der Schwerpunkt gelegt wird, gilt, muss jede Mitarbeit in dieser Richtung begrüßt werden und dies umso mehr als die Schwierigkeiten, die solcher Arbeitsweise aus den gegenwärtigen Zeiten der Einschränkung erwachsen, am besten überwunden werden können durch harmonisches Zusammenwirken.

Unter diesen Gesichtspunkten ist es erfreulich, dass in einem neuen Organ, der „BLUMEA“, die Mitarbeit eines weiteren Kreises erschlossen wird zur Erreichung ein- und desselben Forschungszieles.

Buitenzorg, am 8. Mai 1934.

1) MERRILL schätzt in „New Sumatran Plants“ I (Papers of the Michigan Academy of Science, Arts and Letters XIX, published 1934, p. 149—203) die Anzahl der endemischen Arten auf 40—50 % der gesamt vorhandenen.

ON THE ECOLOGY OF A SPHAGNUM BOG

by

Members of the Leidsche Biologen Club

communicated by

L. G. M. BAAS BECKING and Miss E. NICOLAI.

(Leiden)

Statement of the problem.

For the ecologist systematic units are actors in a play. Whatever their christian- and family-names may be — it is their role, whether master or servant, whether villain or hero — which determines the character of the performance. This performance has, moreover, the property of being both continuous and simultaneous: all scenes are given at once. Such a continuous and simultaneous performance is called a *biocoenosis*.

In a great many ways, a biocoenosis reminds us of an organism. For the coördination between organs or tissues, or even cells is also continuous and simultaneous. A biocoenosis is a higher vital unit, and may be approached by the same methods which we use for the study of organisms (v. D. KLAAUW (24)). In the systematic approach we establish the name, sex and age of the actors, in the anatomical approach the "pattern" of the constitutional units is established ("the dramatical situation"), while the physiological approach is concerned with the metabolism of the entity ("the plot"). As counterpart of these methods, however, we have to consider the study of the environment. The environment, which LOTKA has called "the stage of the life drama" (28).

This environment may be analyzed, and its various factors recorded. A synthetic picture of the environment, the *milieu*, should be the common denominator of the potentialities of the organisms which constitute the biocoenosis.

Our colleague, Professor LAM, has emphasised, in his inaugural address (27) the fact that a taxonomical study "per se", without a stimulus from allied fields of science, such as Geology, Genetics and Ecology, may yield less satisfaction to the investigator than work

plotted in coordination with the related disciplines. This attitude encouraged us to report in this issue upon the results of an Excursion of the „LEYDEN BIOLOGISTS CLUB'', held in the autumn of 1932 to a high-moor region in Drenthe.

Although none of the participants were ecologists and most of the results obtained were well-known in the literature, several of us have derived a stimulus from the field-observations which gave a fresh impetus for laboratory work. And regardless of the fact that men like GAMS (13, 14), HARNISCH (21), KOTILAINEN (25) and in our country W. BELJERINCK (7) did give us synthetic pictures of the high-moor biocoenosis, the experience we obtained was our own, the methods of approach were, in part, different from the others and while we only spent a few days in the field, our group included several persons. As an instantaneous picture, therefore, our survey may have some significance.

In order to use the available time efficiently our study was centered upon a small highmoor pond, and after a preliminary topographical survey the character of its vegetation, of its water and of the climatological conditions was established.

The following members of the „LEIDSCH E BIOLOGEN CLUB'' took part in the work: MISSES T. HOF, A. VAN OVEN, A. KRIJTHE, E. BEER, S. HASPERS, R. BOK and J. DE ZEEUW and MESSRS. K. VAAS, H. VERDAM, CH. NASS and W. KARSTENS. Dr W. BELJERINCK, Director of the Biological Station at Wijster, Drenthe, has given much help and advice. Without his collaboration the work would have been impossible.

D. F. 7, named in Dr W. BELJERINCK's work (6), is an almost circular pond, situated in a slight depression in an open heather, halfway between Wijster and Spier. The diameter is 75—85 meters, the maximum depth is 2.2 meters, the area 0.6 Hectare (see Fig. 1). The heather slopes gently towards the N.W., and it seems that the bog drains in this direction. The Western part is covered by an almost closed cover of *Sphagnum medium* LIMPRICHT, in which there are many "kopjes" of *Calluna* and *Molinia*. The Eastern part is chiefly open water with islands of *Carex inflata* and *Calluna* + *Molinia*, partly with a sandy bottom.

The bog-ore stratum does not fully extend under the pond, the bottom sand, however, is almost stony-hard and seems quite impervious. The N.E. shore is steep and shows the effect of water erosion. The prevailing winds are S.W. As may be seen from the block-diagrams (Fig. 2),

in which the bog is divided in to eight "Meter-blocks", running S.W. to N.E., the Sphagnum forms more than 2 M. deep masses. In the centre of the pool curious ripples exist on the bottom.

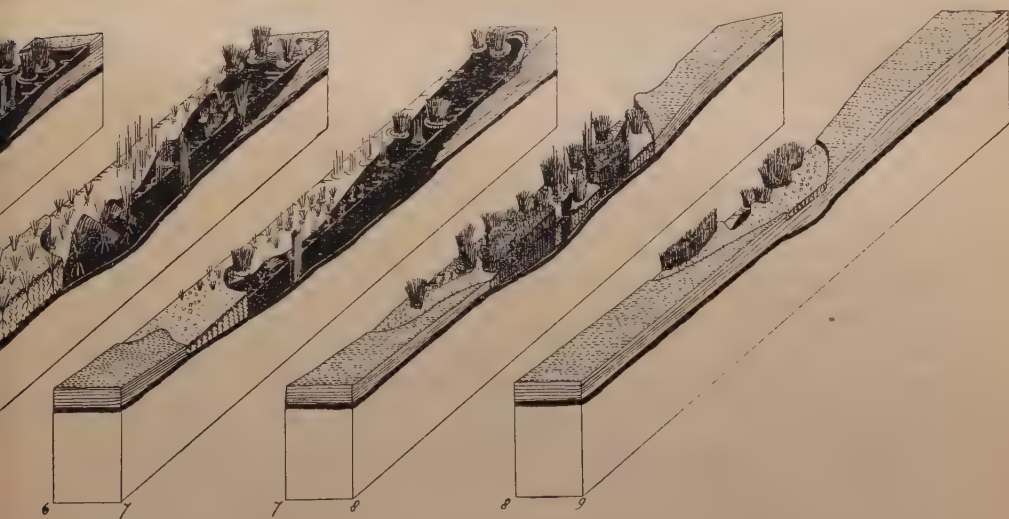
The character of the pond is that of an ombrogenic high-moor pond of the "Solle" type (according to the nomenclature of the German phytogeographers).

Methods of approach.

The pool does not represent a closed community. Possibly there are no exclusive biocoenoses on this earth because, even in the deepest mines, there is constant infection from the atmosphere, which carries a great amount of animated matter in the form of spores and cysts.* Motile organisms may also carry seeds and spores; birds, lizards and insects may cause a wide distribution of plants in the heather. The characteristic community will develop in spite of the "exposed" topography by the exclusiveness of its milieu, and therefore the factors of this milieu have to be analysed.

In ecological surveys much stress has been laid upon an accurate inventarisation of the existing organisms. While such a survey is, of

* The occurrence of the common Stickleback (*Gasterosteus aculeatus*) in D.F. 7 has remained a puzzle to us.



course, very pertinent to a possible understanding of a vital community, it seems remarkable that the environmental factors (despite the perfection of the methods by which they may be determined) are, in many cases, neglected. By selecting a small area for our investigation the survey could be sufficiently restricted to allow for sufficient time to be devoted to environmental factors. Our survey was therefore specified as follows:

1. Topography.
2. Land animals (Investigated by Dr H. BLÖTE and a group of students. Miss A. M. BUTENDIJK (11) found two species of Collembola as new for the Dutch fauna: *Deuterosminthurus insignis* (Reut.) and *Deuterosminthurus novemlineatus* (Tullb.). Other results are as yet not available.
3. Aquatic animals (Investigated by Prof. Dr H. BOSCHMA and a group of students. Results as yet not available).
4. Higher plants.
5. Algae.
6. Microbes.
7. Mineral environment; dissolved substances and gases.
8. Acidity.
9. Temperature and humidity.
10. Pollen analysis of different strata.

In the short time available for our work no complete set of data may be expected. We have endeavoured to remedy some of these deficiencies by later excursions to Wijster and by laboratory work, the details of which will be reported upon in the following chapters.

4. The distribution of the higher plants.

A rough survey of this distribution is given on the map, Figure 1. The open water is almost free of vegetation at the N-E-end, except for the *Molinia-Calluna* "kopjes" and a few areas of *Heleocharis multicaulis* Sm. At the E-end a fairly large patch of *Carex inflata* Huds. (= *Carex rostrata*) occurs. This plant is also dominant in the central portion of the pond, in a zone running from S to N, interrupted only by occasional areas of *Sphagnum*. *Eriophorum angustifolium* Honckeney, and *Rhynchospora alba* Vahl are abundant over the entire W-area and also occur at the S-shore. The submerged moss-vegetation of the open water consists almost entirely of *Lophozia inflata* var. *laxa* and of *Sphagnum recurvum* P. d. B., as already mentioned by Dr W. BEIJERINCK

in his survey of 1926. It seems that the nature of the pond has not changed much in the last six years; possibly the pond has assumed a slightly less oligotrophic character, which also appears from the algal flora.

A more detailed survey was made of a few selected 30 ft traverses at the S-W end of the pond (see Fig. 3) where 4×30 square feet were

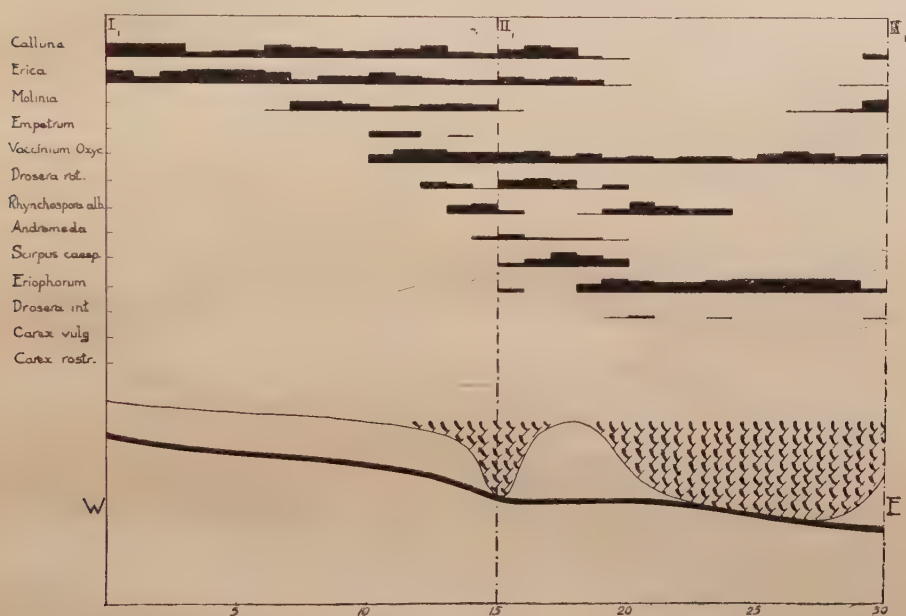


Figure III.

Frequency of different species on a traverse.

S—E at the S—W and of D.F. 7.

As shown in Figure I.

indexed on frequency ("Deckungsgrad", see e.g. MARKGRAF [29]) of the following species:

Calluna vulgaris Salisb., *Erica Tetralix* L., *Molinia coerulea* L., *Empetrum nigrum* L., *Vaccinium oxycoccum* L., *Drosera rotundifolia* L., *Rhynchospora alba* Vahl., *Andromeda polifolia* L., *Scirpus caespitosus* Hartm., *Eriophorum angustifolium* Honckeny, *Drosera intermedia* Dreves and Hayne, *Carex fusca* All., *Carex inflata* Huds.

The profiles I, II and III, show frequency and topography, *Calluno-Molinietum Sphagnetum* on the traverse with a "kopje" near II.

The appearance of the different components as a function of depth of the moor is striking. This also appears from the other W—E and the two S—N profiles (see Fig. 2).

Averaging the results of 120 square feet it appears that the various species may be classed as follows:

	Depth of bog (in cm.)		
	Minimum.	Average.	Maximum.
Calluna	0	15	20
Erica	0	30	60
Molinia	0	35	60
Empetrum	0	10	20
Carex fusca	0	20	20
Dros. rotund.	0	55	(0—>120)
Oxycoccus	2	70	(0—>120)
Trichophorum	3	20	(0—30)
Andromeda	5	20	(5—30)
Drosera intermedia	15	25	(10—30)
Eriophorum	15	40	(10—60)
Rhynchospora	25	40	(10—>100)
Carex inflata	30	—	>120

Much significance cannot be attached to these figures, however, as *Drosera intermedia* also occurs on sandy "transition" moor together with such forms as *Pedicularis*, *Lycopodium inundatum*, *Rhynchospora fusca* etc., in the *Rhynchospora alba* association. Forms like *Eriophorum angustifolium* also thrive on a solid soil. *Carex inflata* seems, in many cases, actually to reach the soil in very deep Sphagneta. Various *Carex* plants were dug up, and down to a depth of 120 cm., the roots seemed to reach the bottom. The same was the case with *Heleocharis* which, however, prefers open water and needs the contact for anchoring. In the case of the *Carex* it might be that the plants actually derived other benefit from the substratum (see also POND [38]).

As the pH of the water in the entire "basin" amounted to 4 (see later) we might expect eury-oxophilous to eury-mesohilous plants according to the Swedish classification (see GLAMS and RUOFF [17]). It seems, however, that the occurrence does not seem to fit in this scheme, according to which this plant should occur in environment with pH 5—6.5 (steno-mesohilous). GLAMS himself points out this discrepancy in a later paper (GLAMS [16]). The great influence of pH upon the

distribution of plants cannot be denied (GUSTAFSON [20], ARRHENIUS [2]) but it seems that a rigid classification, based on pH *only*, may not account for the distribution of a group of plants which belong to the same biocoenosis. Root-structure, anaerobiosis, nature and depth of the substratum may all be factors that control a distribution.

According to Dr W. C. DE LEEUW there are indications that the following plant communities are present according to the system of BRAUN BLANQUET (10).

The boundary of the bog consists of an *Ericetum tetralicis* (1) followed by a *Sphagnetum medii* (2) and a *Rhynchosporietum albae* (3). Fragments of a *Heleocharietum multicaulis* (4) *Caricetum inflato-vesicariae* (5) and of a *Caricetum fuscae* (6) probably are also represented.

Plants (* are found in D. F. 7) indicating the first three associations (several of them being "characteristic species") are:

1. *Ericetum tetralicis*.

<i>Erica tetralix</i> *	<i>Scirpus caespitosus</i> *
<i>Calluna vulgaris</i> *	<i>Carex panicea</i>
<i>Molinia coerulea</i> *	<i>Sphagnum compactum</i>
<i>Juncus squarrosus</i>	(<i>Cladonia rangiferina</i> *)

2. *Sphagnetum medii*.

<i>Vaccinium oxycoccus</i> *	<i>Sphagnum acutifolium</i>
<i>Andromeda polifolia</i> *	„ <i>molluscum</i> *
<i>Drosera rotundifolia</i> *	„ <i>recurvum</i> *
<i>Empetrum nigrum</i> *	<i>Aulacomnium palustre</i> *
<i>Eriophorum vaginatum</i> *	<i>Polytrichum commune</i>
<i>Sphagnum medium</i> *	„ <i>strictum</i>
„ <i>rubellum</i> *	

3. *Rhynchosporietum albae*.

<i>Rhynchospora alba</i> *	<i>Rhynchospora fusca</i>
<i>Drosera intermedia</i> *	<i>Zygogonium ericetorum</i>
<i>Eriophorum angustifolium</i> *	<i>Sphagnum recurvum</i> *
<i>Lycopodium inundatum</i>	„ <i>cuspidatum</i>

The fragments 4), 5) and 6) all belong to a more eutrophic flora.

5. The Algae.

An unusual algal flora should be expected in the acid water of the high-moor bog DF 7.

BEIJERINCK (7) has investigated the flora and fauna of a great many peat bogs on the high-moor of Drenthe including DF 7. It seemed worth while to reexamine the flora for possible changes between the years 1927 and 1932.

The following samples were taken of the plankton of the peat bog on the afternoon of August, 30th;

three samples from the open water,

one of squeezed-out *Sphagnum cuspidatum* growing in a depression near the Callunetum,

one of squeezed-out *Sphagnum magellanicum* on a "kopje" near the Callunetum and one of squeezed-out *Leucobryum* and *Sphagnum rubellum*.

The examination could not be undertaken on the spot, except for a few preliminary observations. Further examination was made on formalin-material by Mr. K. VAAS. Due to this fixation most of the Flagellates became irreecognizable.

In the following list of species those observed by BEIJERINCK (1927) are marked with B, those by VAAS (1932) by V.

TABLE I.
Algae of DF 7.

Flagellatae.

Spongemonas. uvella	B	
Rhipidomonas Huxleyi	B	
Mallomonas caudata	B	
Synura uvella	B	V
Dinobryon divergens	B	V
Cryptomonas ovata	B	
Trachelomonas volvocina	B	
Goniostomum semen	B	
Glenodinium uliginosum	B	
Peridinium cinctum, var. palustre	B	V
„ inconspicuum	B	V
„ lubiniense	B	
„ minusculum	B	
„ pusillum	B	

Chlorophyceae.

Asterococcus superbus	B	V
Oocystis solitaria	B	
Tetraedron enorme	B	

<i>Binuclearia tatrana</i>	B	
<i>Microspora floccosa</i>	B	
„ <i>tumidula</i>	B	V
„ <i>spec. div.</i>	B	V
<i>Oedogonium Itzigsohni</i>	B	V
„ <i>spec. div.</i>	B	V
<i>Zygogonium ericetorum</i>	B	
<i>Mougeotia spec. div.</i>	B	V
<i>Spirotaenia fusiformis</i>	B	
<i>Cylindrocystis Brebissonii</i>	B	
<i>Penium spirostriolatum</i>	B	V
<i>Netrium digitus</i>	B	V
<i>Closterium acutum</i> var. <i>Linea</i>	B	
„ <i>Jenneri</i>	B	
„ <i>juncidum</i>		V
„ <i>Ulna</i>	B	V
<i>Tetmemorus Brebissonii</i> v. <i>minor.</i>	B	V
<i>Euastrum binale. div.</i>	B	V
<i>Micrasterias truncata</i>	B	V
<i>Cosmarium amoenum</i>	B	
„ <i>Cucurbita</i>	B	V
„ <i>Portianum</i>	B	
„ <i>pygmaeum</i>	B	
„ <i>pyramidatum</i>	B	
„ <i>subtumidum</i>	B	V
„ <i>trachypleurum minus</i>	B	
<i>Xanthidium antilopaeum</i>	B	
<i>Arthrodesmus incus</i>	B	
„ <i>octocornis</i>	B	V
„ <i>Brebissonii</i>	B	
„ <i>dejectum</i>	B	V
<i>Staurationum furcatum</i>	B	V
„ <i>margaritaceum</i>	B	V
„ <i>paradoxum</i>	B	V
„ <i>polymorphum</i>	B	
„ <i>teliferum</i>	B	
<i>Hyalotheca dissiliens</i>		V
<i>Gymnozyga moniliforme</i>	B	V
<i>Spondylosium pulchellum</i>	B	V

Heterocontae.

<i>Botryococcus Brownii</i>	B
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Baccillariales.

<i>Tabellaria floeculosa</i>	B	
<i>Eunotia Arcus</i>	B	
„ <i>gracilis</i>	B	
<i>Navicula Rhomboides</i>	B	V
<i>Pinnularia linearis</i>	B	V
<i>Nitzschia gracilis</i>	B	

Cyanophyceae.

<i>Chroococcus turgidus</i>		V
<i>Hapalosyphon hibernicus</i>	B	V
<i>Aphanizomenon flos aquae</i>	B	V
<i>Microchaete tenera</i>	B	

A great many common filamentous algae (*Cladophora*, *Vaucheria Spirogyra*) do not occur in the water of the peat bog. The absence of those algae is due to the acid nature of the water and to its dearth in Calcium. Many of the blue-algae have a brownish colour, as already described by GETTLER (18) for similar localities.

The plankton of the open water contains the greater part of the filamentous algae, whereas the Desmidiacea and especially their smaller forms occur in the samples of squeezed-out *Sphagnum*.

It stands to reason that the amount of species observed by VAAS is a great deal smaller than the list given by BELJERINCK because of the limited material at our disposal. The more striking is the fact that VAAS has found a few species that did not occur in DF 7 in 1927, the year when it was examined by BELJERINCK.

Under those forms we mention *Hyalotheca dissiliens* (Smith) Bréb., *Closterium juncidum* Ralfs, *Chroococcus turgidus* (Kütz) Näg.

The last form also occurs in a near-by pond, so that its area might very well have been extended in the last few years.

Hyalotheca dissiliens was also found by one of us on the reexamination of the natural environment in the autumn of 1932. On this occasion *Cosmarium sphagnicolum* and *Closterium linearis* were also added to the list. The algal flora seems to have increased in the last five years.

6. The Microbes.

The high actual acidity precluded the existence of many forms that ordinarily occur in natural waters. The investigations of VAN NIEL (32) for example, show that purple and green bacteria cannot thrive in acid waters; the same is true for *Cytophaga hutchinsonii*, which attacks cellulose, and of *Azotobacter chroococcum*, which forms atmospheric nitrogen and *Bacillus stutzeri*, a denitrifier.

Other forms like *Aspergillus*, *Phycomyces* and the *Thiobacillus thiooxydans*, forms either adapted to a high acidity or ubiquitous organisms, might very well occur in the high-moor bogs.

Apart from such predictions, field observations already show evidence of well developed microbial life. The presence of methane and sulphuretted hydrogen for instance point to bacterial activity.

As far as the literature is concerned there are very few helpful statements as to the presence of specific organisms, apart from the work on humus-fungi carried out by OUDEMANS and his collaborators (33).

WAKSMAN (46) who has made an intensive survey of microbial activity in peat-bogs, seems to be chiefly interested in decomposition of plant-remains, both aerobically and anaerobically, and does not describe specific forms.

ITTER (39) mentions the occurrence of butyric acid fermentation in the bogs caused by typical *Clostridia*.

SCHLÖSSENG (40) observed the disappearance of methane when the cultures were infected with heather-soil.

Evidence of bacterial activity as shown by the presence of volatile acids will be discussed later in this paper.

Dr W. BELJERINCK demonstrated the presence of bacteria in the air-cells of *Sphagnum cymbifolium* and Miss A. VAN OVEN corroborated this fact. It seems, therefore, that a copious bacterial flora exists in peat-bogs and a more detailed investigation was desirable. This investigation has to be considered, however, as a preliminary survey.

Samples of bog-water were collected in evacuated soft-glass tubes drawn out to a fine point, which point was heated in a flame before immersion. After immersion the point was broken off and the filled tube sealed with Sphagnum as the "Primus-burner" did not give sufficient heat to seal the tube.

Mud from the bottom of the peat-bog and different species of Sphagnum were collected in sterilized bottles.

A direct survey of the microbes was only possible in the above mentioned case of Sphagnum-plants.

For further investigation of the bacterial flora, carried out by Miss A. VAN OVEN, the samples were inoculated in various culture-fluids.

Those fluids were intended to give the optimum conditions for the growth of different species of bacteria, in order to obtain an accumulation of these special bacteria.

Two series of each culture-fluid were examined, one having the original composition as cited in the literature, the other similar to the former but adjusted to a pH of 4.

The following species of bacteria could be obtained:

a. *denitrifying bacteria*, isolated in a medium used by ELEMA (13) containing 2 % glycerol and 0.5 % KNO_3 , buffered to pH 4 by means of citric acid. Under anaerobic conditions development of gas could be observed within a week.

Gas- and bacterial development proved to be more copious in the cultures adjusted to pH 4.

The gas proved to be a mixture of carbon dioxide, oxygen and nitrogen. A pure-culture on peptone-agar showed white colonies of rod-shaped Gram-negative bacteria, 1—4 μ in length.

b. *aerobic thiobacteria*, cultivated in a solution indicated by KÜSTER (26) containing $\text{Na}_2\text{S}_2\text{O}_3$, NaHCO_3 , NH_4Cl and MgCl_2 ; one series buffered to pH 4, the other by means of K_2HPO_4 to pH 5.4.

The aerobic cultures showed a marked development of bacteria indicated by the production of sulphur.

In this case too the culture-fluid adjusted to pH 4 showed a more copious development of the microbes.

Pure-cultures on peptone-agar and microscopical investigation showed no difference whatever between those forms and the denitrifying bacteria. It seemed justified to try the aerobic Thiobacteria on denitrifying power in anaerobic cultures and vice-versa.

Those cultures succeeded, so probably both processes are due to the action of one and the same organism.

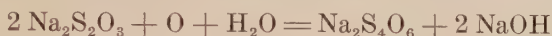
A further investigation on this subject was carried out by Miss T. HOR in the Microbiological Laboratory at Delft.*

Miss HOR inoculated the Thiobacteria from a pure culture on

* The Director of this Institute, Prof. Dr A. KLUYVER, has given us much helpful assistance.

peptone-agar in a medium described by BELJERINCK (5) containing $\text{Na}_2\text{S}_2\text{O}_3$, NaHCO_3 , NH_4Cl , MgCl_2 and KH_2PO_4 instead of K_2HPO_4 ; adjusted to a pH of 4 by means of phosphoric acid. The decomposition of thiosulphate was controlled by titration with iodine; after six days a disappearance of thiosulphate could be observed; the pH increased from 4 to 8. In the fluid neither sulphate nor sulphur were formed.

Very likely the following reaction takes place:



In this case the increasing pH is due to the formation of NaOH.

The various reactions obtained with the *Thiobacillus* of Wijster showed a marked resemblance with forms described by TRAUTWEIN (46).

Therefore the bacteria were cultured in the medium as given by TRAUTWEIN ($\text{Na}_2\text{S}_2\text{O}_3$, NaHCO_3 , NH_4Cl , MgCl_2 , K_2HPO_4) but adjusted to a lower pH by replacing K_2HPO_4 by KH_2PO_4 and by addition of phosphoric acid.

In the fluid adjusted to pH 4 no growth of bacteria took place; in a fluid of pH 5.5 the bacteria developed well as was shown by the fact that within two weeks the whole amount of thiosulphate had disappeared and the pH increased from 5.5 to 8.

The only difference with TRAUTWEIN's *Thiobacillus* seems to be that the latter causes the formation of tetrathionate and of sulphate, whereas the *Thiobacillus* of Wijster does not produce sulphate in the fluid.

The production of polythionates could be proved by addition of bromine to the culture-fluid which caused the formation of sulphate.

TRAUTWEIN's *Thiobacillus* causes denitrification both under autotrophic and under heterotrophic conditions (47), whereas Miss HOF tried in vain to obtain denitrification with the *Thiobacillus* of Wijster.

Considering the fact that Miss VAN OVEN obtained denitrification with the same bacteria in the same media, the different observation might be explained by a loss of the faculty of denitrification caused by prolonged culture on peptone-agar. BELJERINCK (6) described a similar case: bacteria which caused denitrification with Sulphur as a source of energy lost this faculty after culture on organic media.

In this case no further observations have been made and the question remains open whether the *Thiobacillus* of Wijster is able to cause denitrification.

In any case the form seems to be related to TRAUTWEIN's *Thiobacillus* (46).

c. *Sulphate-reducing bacteria* developed only in the cultures inoculated with bottom-mud from the bog. After two weeks the culture-fluid of BAARS (3) became black by the formation of PbS.

The cultures inoculated by samples of bog water showed no such development of bacteria whereas in a few cases the inoculation with Sphagnum plants gave a development of bacteria after 4 weeks.

The bacteria observed were Spirillae and rod-shaped bacteria; pure cultures did not succeed.

d. *Butyric-acid bacteria* developed abundantly from mud, water and Sphagnum-inoculations under anaerobic conditions; the media contained glucose and fibrin or soluble starch and fibrin.

Microscopical examination showed plectridia about 4μ in length.

In the solutions buffered to pH 4.3 the bacteria caused a slight increase of the pH to about 4.5; in cultures with an initial pH of 7 a decrease occurred down to pH 4.5.

The butyric-acid bacteria seem to form an important part of the microbiological flora of the peat-bog, as was observed already by RITTER (39).

As to the occurrence of cellulose-decomposing bacteria no definite observations have been made. Only in one case a slight decomposition of cellulose could be observed. In this case 1 gram of straw and 5 cc. of a sample (mud or water) were added to a solution according to WAKSMAN (50), containing $(\text{NH}_4)_2\text{PO}_4$, MgSO_4 , KCl and K_2HPO_4 . Cultures both under aerobic and anaerobic conditions showed a beginning of decomposition after three months. Small rod-shaped bacteria were present.

Examination of the water and mud of the peat-bog on the presence of Fungi was carried out by inoculation on prune-agar buffered to pH 4. A Fungus developed and could be classified by the Central Bureau of Fungus Cultures at Baarn as *Syncephalastrum cinereum* Bainier.

7. The environment.

Mineral environment and gases.

One of the most striking characteristics of high-moor bogs is the oligotrophic character, the dearth in mineral substances. The following analysis of the water of DF'6, a peat-bog near to DF7, carried out by the Central Bureau of Hygiene in the spring of 1926 is a sufficient proof of this fact.

TABLE II.

Free carbon dioxide	6.1 mgr/litre
Fe ₂ O ₃	0.1 "
CaO	3.3 "
MgO	3.0 "
P ₂ O ₅	0 "
K ₂ O	0 "
Cl-	12 "
Total amount of nitrogen	1.6 "
Oxygen consuming capacity	7.4 "
Free oxygen	10.5 "
Temperature during the determination of the oxygen ...	14.5° C.

DF 7 belongs to the typical high-moor bogs which probably do not communicate with the ground-water, therefore its mineral composition depends entirely on the rain-fall. In relation to this fact it seemed interesting to obtain an analysis of the rainwater. This analysis was made by the "Government Bureau of Water Supply" (Rijksbureau voor Drinkwatervoorziening) of a sample taken in the spring of 1933.

TABLE III.

Conductivity at 18° C. $\times 10^6$	29
Cl-	4.9 mgr/litre
NO ₂ ⁻	0 "
NO ₃ ⁻	0 "
SO ₄ ⁼	7.5 "
Ca	3.3 "
Ca as CaO	4.6 "
Mg	0.7 "
MgO	1.2 "
Na	4.9 "
Total hardness	0.63

During the excursion the chemical survey of the bog-water was limited to the analyses of oxygen, carbon-dioxide and sulphuretted hydrogen.

The presence of volatile organic acids was examined in the laboratory at Leyden.

The amount of dissolved oxygen was determined by the original method of WINKLER (54), the samples have to be collected with great

care in order to avoid the entrance of air-bubbles into the bottle. Therefore the sample bottle was connected with an aspirator; by applying suction to the outlet of this aspirator the water was flushed through the sample bottle into the aspirator.

To the samples were added successively manganous sulphate, alkaline potassium iodide solution and sulphuric acid. The iodine set free is a measure for the amount of dissolved oxygen and may be titrated easily with a solution of sodium thiosulphate.

The results were expressed in percentage of saturation by using a graph in which the correlation between oxygen in mgr/litre and temperature of the sample is given.

It was dubious whether this method could give the exact amount of oxygen in the sample because of the presence of organic matter in the water; and above all the relatively large amount of sulphuretted hydrogen appeared as a source of errors.

In order to avoid those errors the samples were treated at first with concentrated sulphuric acid and a potassium permanganate solution, as indicated in the "Standard methods for the Examination of Water and Sewage" (45).

As the last method gave very uncertain results and as many objections were made to it (ALSTERBERG [1]), the results obtained by the original WINKLER method seemed preferable with the restriction that the results should be a little too high.

In the literature the dearth of oxygen is considered as one of the characteristics of the peat-bogs (PEUS [37]). HARNISCH (21) observes that in small bogs when the water is not disturbed a total lack of oxygen occurs, whereas in larger bogs the surface is stirred by the wind and may contain a considerable amount of oxygen. For our small pond one could expect a low saturation value. This prediction proved to be true. Two samples were collected at two localities; in the open water and in a depression of the Sphagnetum where the greatest changes were bound to occur in connection with photosynthesis; at the same time water from the surface and from a deeper layer (10—20 cm below the surface) was sampled.

The percentage of saturation was small, the highest amount in the Sphagnetum being 20 %, in the open water 93 %. A rapid decrease was observed in the deeper layers.

Figure 4 shows the variation in oxygen-saturation of a depression in the Sphagnetum during a day and a night, the samples being taken at 1 cm. and at 10 cm. below the surface.

It may be seen that the amounts of oxygen increase in the surface water during the morning and that a maximum occurs between 13 and 15 hours, followed by a rapid decrease and a minimum at midnight.

The difference between surface and deeper layers needs no further explanation.

It proved to be interesting to compare those results with the data obtained for the amount of sulphuretted hydrogen (as shown in the same Figure). Sulphuretted hydrogen was determined by adding to the

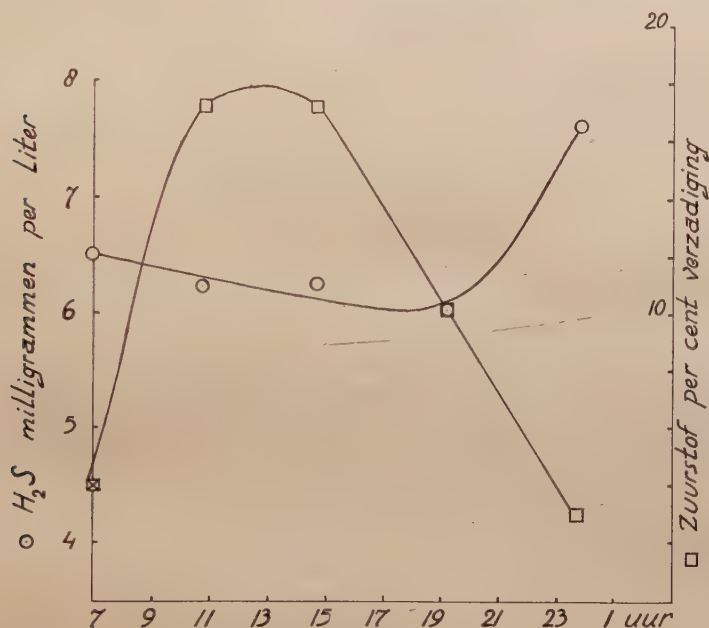


Figure IV.

H_2S and oxygen-content of the water during the day.

samples a known amount of standardized iodine solution and by titration of the excess of iodine with sodium thiosulphate. In August the amount of H_2S varied from 4.3—7.82 mg/L. As the samples for this examination were collected together with the samples for the oxygen determination the results could well be compared and the figure shows a minimum of H_2S when the amount of oxygen has reached its maximum whereas with decreasing amount of oxygen the H_2S increases and reaches its maximum after midnight.

So there was observed a striking correlation between the amounts of these two dissolved gases.

The third gas dissolved which was subject to our investigations was the carbon dioxide.

Carbon dioxide may be present in natural waters in three forms: free carbon dioxide or carbonic acid, bicarbonate and carbonate.

As the pH of the water of DF 7 proved to be 4, at this acidity the carbon dioxide occurs only in its free form; the amount of carbonate and of bicarbonate is so small as to be negligible.

This may be easily derived as follows:

$$k_1[\text{H}_2\text{CO}_3] = [\text{H}^+] \cdot [\text{HCO}_3^-] \quad (1)$$

$$k_1, \text{ the dissociation constant} = 3.5 \times 10^{-7}$$

The bicarbonate dissociates to carbonate:

$$k_2[\text{HCO}_3^-] = [\text{H}^+] \cdot [\text{CO}_3^{2-}]$$

$$k_2 = 4.7 \times 10^{-11}$$

As the concentration of hydrogen ions occurs in those equations, the influence of the pH on the ratio of the three forms of carbon dioxide will be of great importance.

When we take the total amount of carbon dioxide as 100, a third equation is:

$$[\text{H}_2\text{CO}_3] + [\text{HCO}_3^-] + [\text{CO}_3^{2-}] = 100,$$

and combination with the other equations yields:

$$\text{H}_2\text{CO}_3 = \frac{100}{1 + \frac{k_1}{[\text{H}^+]} + \frac{k_1 k_2}{[\text{H}^+]^2}}$$

In the water of DF 7 the pH is 4, so for the concentration of the hydrogen-ions we substitute $[\text{H}^+] = 10^{-4}$, which gives an amount of H_2CO_3 of 99.99 %.

It is quite clear that the amount of bicarbonate may be neglected.

The method given in the literature for the determination of free carbon dioxide is by titration with a solution of 1/44 N. sodium carbonate with phenol-phthalein as an indicator.

Considering the high acidity of the water of the peat bog it is improbable that this low pH is due only to the presence of carbon dioxide (see below).

With a solution of sodium carbonate we do not only determine the amounts of carbon dioxide but the sum of all acids present in the water.

In consequence the results obtained by means of this method for the amount of carbon dioxide must be too high.

We tried to apply another method for the determination of the carbon dioxide. At first this method seemed unpracticable for field work but after some improvement it gave reliable results.

The principle is to lead an air-current, free from carbon dioxide, through the boiling water-sample into an Erlenmeyer-flask filled with barium hydroxide solution; the main current was divided into two smaller ones, one of which reached a flask with Ba-hydroxide directly, the other after passing through the boiling water sample.

Both Erlenmeyer-flasks contained the same amount of barium hydroxide and by titration with a standard solution of hydrochloric acid, the difference of the acid required gave a measure for the amount of carbon dioxide.

HÖLL (22) has investigated a great many peat bogs on their chemical composition; his data for carbon dioxide amount to 25 mg./L.; HÖLL states that in winter an amount of 30 mg./L. may be expected. HÖLL's data are obtained by titration with sodium carbonate.

Bij means of the new method the highest amount observed in DF 7 was 7 mg./L.

In the month of October the following data were observed:

TABLE IV.

Locality	Temperature of water	pH	mg./L. CO ₂	mg./L. CO ₂
			new method	titration method.
Sphagnetum DF 7	9.6	4.0	6.7	15.0
Open water DF 7	9.6	4.1	6.4	7.6
" " "	7.8	4.0	5.76	9.75

In view of the data obtained we suspect that the data given in the literature for the amount of carbon dioxide in acid waters are probably too high. This is due to the method used and therefore a new method (in this case titration with barium hydroxide) should be preferred.

Quantitative changes in the three gases may be due to biological processes.

8. The acidity.

We had occasion to mention several times the high acidity of the high-moor peat bogs. To this acidity the peat owes its preserving qualities, as a great many bacterial processes are excluded in this range of pH.

Before discussing the possible causes of the low pH we will mention the observations made on the water of DF 7.

Determination of pH was carried out by means of the colorimetric method. To the buffers (SÖRENSEN and CLARK) were added indicators suited to the special range; addition of the same indicator (Brom-cresole-green or Brom-thymol-blue) to samples of the bog water and comparison of the coloured buffers allowed us to determine the pH of the water with an accuracy of 0.1.

The values of the pH were situated in the range from 3.7—4.1, the highest, 4.1, being observed in the open water of the bog directly after a rain storm; before the storm the pH was 4. This sudden increase of the pH demonstrates the fact that the bog water has no buffer-capacity.

The values for pH below 4 were observed in the Sphagnetum.

Observations during 24 hours showed no changes in the values for the pH except in one case, when the water of the Sphagnetum had a pH of 3.8 in day-time; the same night the pH had increased to 3.9.

A low pH could be expected from the literature. Several causes may contribute to explain this high acidity, the most plausible of which will be discussed here:

1. In the first place the amount of carbon dioxide is often considered as the important causal agents (HÖLL [22]).

This author apparently overestimated the capacity of this factor as shown by the following observations:

- a. the bog water was boiled thoroughly in a hard-glass test tube; the increase of the pH did not exceed 0.2; in many cases no increase at all could be observed.

As we may expect that the whole amount of carbon dioxide is driven out by boiling the water, the gas does not seem to have much influence on the acidity of the water.

- b. Due to photosynthesis the Sphagnetum should show considerable difference in pH during the day and night, if the acidity were chiefly caused by the carbon dioxide.

No such changes were observed by us, in accordance with MUENSTER-STRØM (31) who found that in the high-moor waters in Norway, where great quantities of green algae were actively assimilating, no increase in the pH could be observed.

c. The pH caused by a certain amount of carbon dioxide may be calculated very easily. According to JOHNSTON (23) carbonic acid, excess base $[B^+]$ and hydrogen-ion-concentration $[H^+]$, are related as follows:

$$[H_2CO_3] = \frac{\{[B^+] + [H^+]\} [H^+]^2 - k_w [H^+]}{k_1 [H^+] + 2 k_1 k_2}$$

(k_w being the dissociation-product of water).

In case of the bog water $[B^+] = 0$ and substitution of H_2CO_3 yields $[H^+]$ and, accordingly, pH.

Substituting the maximal amount observed in DF 7 (6.7 mg./L.) a pH of 5.3 should be the result, whereas the maximal amount given by HÖLL (30 mg./L. CO_2) yields a pH of 4.8.

In both cases the pH is far too high, considering the actual value of about 4.0.

The conclusion seems, therefore, warranted that in the insufficiently buffered milieu the carbon dioxide will cause a certain decrease of the pH, but in no case the low pH should be attributed exclusively (or even for an important part) to the presence of carbon dioxide.

2. The same consideration holds for the influence of sulphuretted hydrogen upon the pH; the amounts present in the bog water may only cause a change in the second decimal place of the pH.

3. Nor can much value be attached to the opinion of SKADOVSKY (42) that ferro- and aluminum salts cause a $pH < 4$ in Russian high-moor bogs. As the analysis of the water of DF 6 gives an amount of ferros less than 0.1 mg./L. no such influence may be expected.

4. The presence of small amounts of organic acids in the water of bogs seems a well established fact.

As the results of the microbiological survey showed the presence of butyric-acid bacteria, it is quite probable that butyric acid and other organic acids are present in the water.

The method of DUCLAUX (12) was used in the laboratory to investigate the presence and quantity of volatile organic acids. By distillation and fractional titration of the distillate the presence of

small and varying quantities of butyric or valeric acids could be demonstrated.

Those acids also contribute to a decrease of the pH but neither of the above mentioned acids may be considered as the main factor in the problem of the acidity, as the amounts were much too small.

Three more important theories remain to be discussed:

5. ODÉN (34, 35) and his school attribute the acidity of bog water to the influence of humic acids,

6. PAUL (36) to an active secretion of an unknown acid by the cell walls of the *Sphagnum*,

7. BAUMANN and GULLY (4) have propagated the idea that humus and the cell walls of *Sphagnum* are able to exchange ions with the environment so that hydrogen-ions are set free by absorption of the kation.

This latter theory, which preceded that of ODÉN, has met with much opposition, but the observations made on the mineral environment of the peat bog have impressed us with its plausibility so that we prefer it to both PAUL's or ODÉN's speculations.

The observations on the humic acids carried out by ODÉN and his collaborators lead to a division of the humic acids in three groups; one of them, the "fulvic-acid" group, constitutes the soluble substance, and, according to ODÉN, the cause of the brownish-yellow colour of the water in peat bogs is due to fulvic acids. No further observations have been made about the composition and chemical properties of the fulvic acids.

The water of DF 7 had a yellow colour, but could be made colourless by filtration through a Seitz filter; as the pH did not change after the filtration there seems to be no correlation between the yellow colour (eventually caused by fulvic acids) and the pH.

The other humic acids are considered by ODÉN as to be tetrabasic acids. By measurement of the conductivity ODÉN concludes that they are able to cause a low pH when dissolved.

WEHRLE (53) attributes a great importance to the presence of humic acids in the bog waters of high-moors, but HÖLL has opposed this statement of WEHRLE by referring to a great many peat bogs with a low pH and apparently, without humic acids.

Considering those observations and the uncertainty of the composition of those acids, the chief cause of the high acidity cannot be attributed to a direct influence of those acids. Their possible in-

direct influence will be treated under the discussion of the theory of ionic exchange.

PAUL's observations on the "Kalkfeindlichkeit" of *Sphagnum* have lead him to believe that the *Sphagnum* plants secrete an acid; in an alkaline milieu the acid is immediately neutralized and the plant proceeds to produce more acid, by which overproduction it exhausts itself. The concentration of the alkali has no importance but the total amount seems to dictate the process.

The observations of PAUL have stimulated many investigators to study the problem. By their results it is shown that the different species of *Sphagnum* show a different reaction on the substrate and on the pH of the environment.

The main interest of the later literature on this subject seems to be in the direction of the influence of the substrate on the *Sphagnum* plant, whereas the influence of *Sphagnum* on the environment has been neglected.

BAUMANN and GULLY consider the cell-wall to be a colloid which, when placed in a salt-solution, absorbs the kations exclusively and sets free the acid.

Much opposition to the theory of BAUMANN and GULLY, headed by ODÉN and his school, resulted in the abandonment of the exchange-theory during many years, until FREUNDLICH (15) pointed out its importance for colloid chemistry. Zeoliths and aluminum silicates brought in contact with neutral salts cause a decrease in the pH of the salt solution and FREUNDLICH claims a similar behaviour for the cell walls of *Sphagnum*, based upon the observations of BAUMANN and GULLY.

This so-called "Neutralsalzzersetzung" has since long been subject of many investigations in Soil Science. The experimental fact on which it was originally based is: that an extract of humus-soil in a neutral salt solution (as for instance potassium chloride) shows a higher acidity than an extract of the same soil in pure water.

TRÉNEL and HARADA (48) have given a discussion of the current literature on this subject.

As to the influence of the *Sphagnum* plants on the acidity of the substrate we mention the observations of SKENE (43) who obtained a marked decrease of the pH by growing *Sphagnum* in a solution of sodium chloride.

Further observations were made by STELMACH (44) on the conduct of *Sphagnum recurvum* and *Sphagnum cymbifolium* in solutions of dif-

Another series of, more exact, experiments were undertaken:

Equal volumes of water-soaked *Sphagnum cuspidatum* and *Sphagnum cymbifolium* were submersed in equal volumes of rain water, which had been standing during 24 hours in Erlenmeyer-flasks of Jena-glass in which time the pH did not change.

Table VI shows the results of these experiments:

TABLE VI.

	<i>Sphagnum cuspidatum</i>		<i>Sph. magellanicum</i>		control water
	pH of living	dead	living	dead	
after ½ hour	5.3	5.0	5.0	4.8	5.3
„ 3 „	5.2	4.6	4.4	4.3	5.3
„ 6 „	5.1	4.5	4.4	4.3	5.3
„ 24 „	5.1	4.5	4.4	4.3	5.3
„ 2 and 3 × 24 hours	no further changes were observed.				

The experiments of BELJERINCK show the influence exerted by the *Sphagnum* plant on its environment. Whether this influence (the decrease of the pH) is due to the secretion of acids or to an exchange of ions does not appear from these observations.

Further experiments were carried out by Mr. K. VAAS.

A culture of *Sphagnum cymbiolifum* was used. The plants were placed in Erlenmeyer-flasks of quartz in twice distilled water; we may expect no measurable ion-exchange between the quartz and the water. Thus, if the *Sphagnum* secretes an acid the pH of the distilled water should show a decrease. On the contrary, a slight increase was observed after the lapse of two days, probably due to the changes in the carbon dioxide tension as influenced by photosynthesis and respiration.

By this experiment evidence was obtained that the *Sphagnum* plants do not produce acids in the medium in which they grow.

Other experiments were carried out by placing the *Sphagnum* plants in a very diluted solution of ammonium chloride in quartz or paraffined glass. The composition of the initial solution was exactly determined as well as its pH. During a few days the plants remained in the solution, after which the composition and the pH were reexamined.

Without any exception the amount of ammonium-ions had decreased, whereas no change could be observed in the amount of chloride-ions.

The pH often decreased but there seemed to be no definite correlation between this decrease and the amount of NH_4^+ absorbed by the plants. The uncertainty of these results is in part due to the relative

precision in the method of the NH_4^+ — and Cl^- determination. The latter determination is inexact when compared with the NH_4 -determination, which was carried out spectrocoulometrically. It seems therefore possible that small amounts of chloride or chloride-ion were also absorbed by the moss. Neither were influences of photosynthesis and respiration excluded. It seems more promising to carry out future investigations with dead *Sphagnum*, inasmuch as this material seems equally capable of ionic-exchange. As these investigations would be non-biological, we shall have to rely in the future upon the results of colloid-chemists.

The possibility mentioned by FREUNDLICH, according to which the exchanged kation does not need to be hydrogen but may very well be a metal, also has to be investigated and might have obscured the results of our experiments.

At present the exchange-theory seems the only one, however, which may account for the observed facts.

9. Temperature of air and water.

A maximum and minimum thermometer were placed in a distance of 15 cm. from the bottom in the Caricetum. The temperatures shown by this thermometer differed $1\text{--}2^\circ\text{C}$. from the temperature observed by the meteorological substation at Wyster. This difference may be due to the higher position of the latter thermometer which was placed at a height of 2.25 m. During 24 hours the temperature varied from 15.3°C .— 22.0°C .

The water-temperature showed a marked lag in relation to the air temperature and the fluctuations are damped as compared to the air temperature. The bottom of the pond was always colder. Inverse stratification did not occur.

Humidity.

The humidity-data of the environment were obtained by means of a psychrometer of a very simple construction: the different temperatures of a dry-bulb and a wet-bulb thermometer were used as a measure for the humidity of the air. The "Carrier Engineering Corporation's Psychrometric Chart" mentioned by SHELFORD (41), gives the correlation between temperature of wet and dry bulb and percentage of relative humidity. The relative humidity varied from 70—97 %. The influence of a rain-storm was shown by a sudden increase from 92 % tot 95 % of relative humidity in the afternoon of August 30th.

The evaporimeters used for the measurement of the evaporation

in different layers were constructed of the type of the porous cup atmometer. On the top of a calibrated tube was placed a cup with porous walls; a cotton wick reached from the cup into the water. Evaporation was determined by measuring the loss of water in the calibrated tube. As the instrument had not been standardized, only relative observations resulted from this method.

The atmometers were placed on different levels in the Sphagnetum: 0, 5, 10 and 15 cm. from the bottom. The observations showed a larger amount of evaporation at the bottom — in the Sphagnetum — than was found in the higher layers. Those observations lead us to the view that possibly the Sphagnum should be able to diminish the humidity of the atmosphere by an intensive absorbtion of the atmospheric water.

The following experiments were carried out at the Laboratory at Leyden by Miss A. KRIJTHE and Mr. H. VERDAM to investigate the absorptive capacity of Sphagnum.

Plants of *Sphagnum cymbifolium* were dried in a desiccator over sulphuric acid during two days. Aliquots of this dried Sphagnum were brought under a bell-jar in which was placed a solution of sodium chloride of a known molarity. The material was placed on the scale of a balance and fixed to the beam by means of a paraffined thread which passed through the wall of the bell-jar.

The amount of the water absorbed by the Sphagnum could be determined in this way.

Immersed in water the dried Sphagnum absorbed $10 \times$ its weight.

TABLE VII.

In the bell-jar above water-rel. humidity 100 % Sph.-absorbs $\pm 2 \times$ its weight.

In the bell-jar above 1 mol. NaCl rel. humidity 96.4 % Sph.-absorbs $\pm 1 \times$ its weight.

In the bell-jar above 2 mol. NaCl rel. humidity 91.25% Sph.-absorbs $\pm \frac{1}{2} \times$ its weight.

In the bell-jar above 3 mol. NaCl rel. humidity 86.6 % Sph.-absorbs $\pm \frac{1}{3} \times$ its weight.

In the bell-jar above 4 mol. NaCl rel. humidity 79.5 % Sph.-absorbs $\pm \frac{1}{4} \times$ its weight.

In the bell-jar above 5 mol. NaCl rel. humidity 69.2 % Sph.-absorbs $\pm \frac{1}{5} \times$ its weight.

The relation between relative humidity of the air and amount of water absorbed by *Sphagnum* is clearly shown by the experiments.

10. Pollen-analysis.

At point III, the S—W corner, a hole was dug and samples were taken from every 10 cm down to 60 cm, where the hard sand was encountered. The samples were studied by Miss A. KRIJTHE in the usual way and the relative frequency of the various pollens was

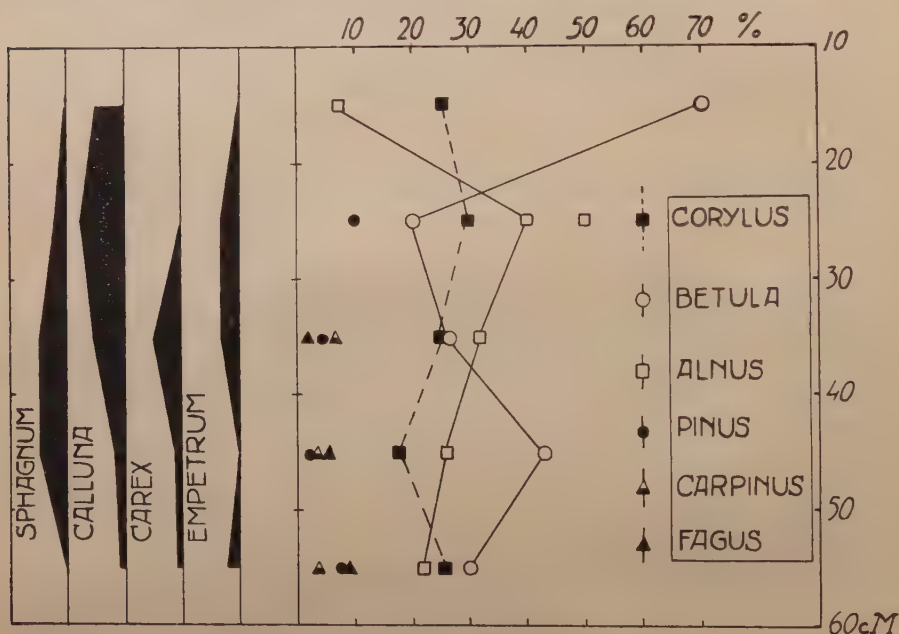


Figure V.
Pollen-diagram from D.F. 7.

established (average of three counts). The % is given of total tree-pollen (genera marked *).

Figure V shows the conventional pollen-diagram as a function of depth. It appears that the only other significant difference from this diagram with other samples from Drenthe (see FLORSCHÜTZ c.s. [14]) is the preponderance of birch-pollen, although the small number of grains found near the surface and near the bank make the percentage-data very uncertain. On the whole, the diagram is characteristic of a young peat of the sub-atlantic to subboreal type. A "pollen archive" of recent plants proved to be very useful. By means of this collection

TABLE VIII.

Depth Genera	10-20 cM. roots and sand		20-30 peat and sand		30-40 dry peat		40-50 wet peat		50-60 sandy peat	
	freq.	%	freq.	%	freq.	%	freq.	%	freq.	%
*Betula.	3	70	2	20	33	26	132	43	14	30
*Alnus.		6	4	40	42	32	77	26	10	22
*Tilia.					2	2	5	2	1	2
*Fagus.					2	2	10	4	4	8
*Quercus. . . .					2	2	5	2		
*Corylus.	1	24	3	30	32	25	49	17	12	26
Myrica.					3		39		8	
Sarothamnus. .	2		2		5		19		3	
*Salix.						1				
*Pinus.			1	10	14	3	5	2	4	8
Sphagnum. . .	5		12		57		55		4	
Carex.	2		1		52		18		12	
Calluna.	10		15		11		3		3	
Erica.			5		4		5		1	
Empetrum. . .									1	
Andromeda. . .	2		2				1			
Vaccinium. . .			4				1		1	
Genista.					1		12		1	
Melampyrum. .							1			
Euphrasia. . .					3		10			
Gentiana. . . .							4			
Campanula. . .							5			
Drosera.									1	
Eriophorum. . .			1		2				1	
Polypodium. . .							2			
Lycopodium?										
*Carpinus. . . .					9	7	10	4	2	4
	25.5		52.25		265		468		83.75	

a fair picture could be obtained of the flora of the strata 30—40 and 40—50 cm respectively.

In the former stratum *Carex*, *Eriophorum* and *Calluna* occur abundantly, while *Myrica*, *Genista*, *Euphrasia* and *Campanula* are more frequent in the deeper layer, where *Calluna* is less frequent. In both cases the dominant trees are birch and alder. The frequency of some plants is given in Table VII together with the tree-pollen.

It may be that the "bank", which forms the lower boundary of the peat, corresponds to the sandy bottom of the pool, and that another layer of plant remains may occur below this stratum.

From this survey it seems, however, that the peat of D. F. 7 is of comparatively recent origin; there appears to be no reason to date it earlier than the subboreal.

The Life-Cycle in a Sphagnum-Bog.

From our field and laboratory experience, scanty as it is, supplemented by a study of the literature, a concept of the life-cycle in a Sphagnum-bog may be derived.

Oligotrophic by the low mineral contents, dystrophic by its high acidity, the waters of the bog represent a very special condition, which condition constitutes a specific milieu. The vital counterpart of this milieu gives us the life-cycle, which is dominated by the poverty in electrolyte and in oxygen and by the extremely high acidity.

D. F. 7 apparently is partly ombrogenic, partly soligenic in nature. The rain water which feeds it, contains Calcium, Magnesium, Sodium, Potassium and Ammonia; sulfate, chloride, nitrate, carbon-dioxide, Nitrogen and Oxygen. The kation will be partly exchanged by the Sphagnum for hydrogen-ions, thus causing the high acidity. The sulfate will be reduced to sulphide which, at the low pH, will form H_2S . The oxygen production by photosynthesis is not able to oxidize all of the H_2S . Aerobically, the H_2S may be oxidized to $SO_4^{=}$ again by autotrophs. Nitrate, if present, will be reduced to nitrogen, while nitrification seems to be inhibited. Due to the presence of butyric acid bacteria, anaerobic fixation of nitrogen does not seem to be excluded.

The formation of methane was demonstrated in the field; anaerobic decarboxylation of lower fatty acids may be its cause. Oxidation of methane and hydrogen is possible, but was not established. Decrease of pH due to the photosynthetic intake of carbon dioxide was only observed in laboratory experiments. In the field the CO_2 contributes

but little to the actual acidity of the bog. The same is true for the organic acids, which occur, moreover, in variable amounts. The presence of valeric- and probably of butyric acid could be demonstrated.

Anaerobic decomposition of cellulose seems very slow; the lignin (or perhaps the ligno-protein) complexes are decomposed but the bacterial components in this process are imperfectly known, despite

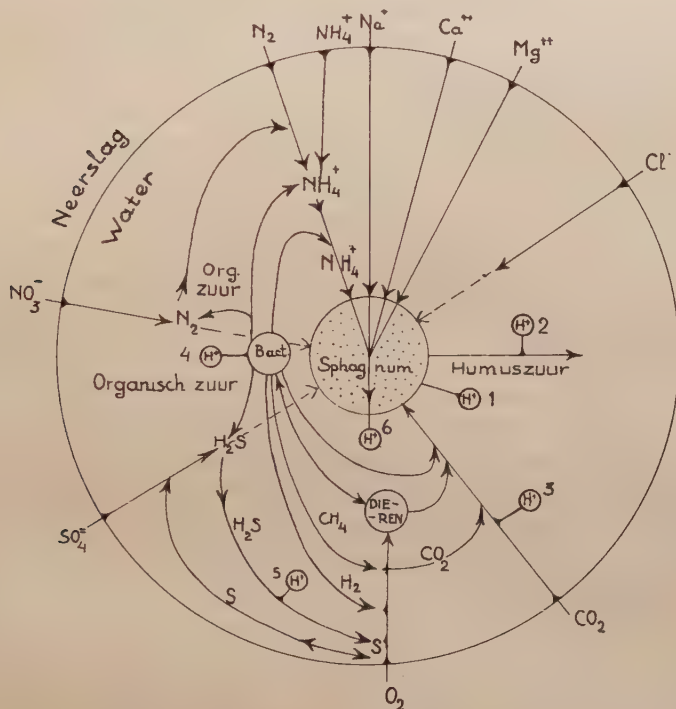


Figure VI.

Life-cycle in a Sphagnum bog.

org. zuur: organic acid.

neerslag: precipitation.

humus zuur: humic acid.

dieren: animals.

the beautiful work of WAKSMAN (52). In view of the work of K. GRIFFIOEN (19) who demonstrated the formation of humic acids from lignins in the heart-wood of Ebony under presumably sterile conditions, it seems possible that many of these reactions might ultimately prove to be non-vital. Figure VI shows a diagrammatical representation of the life-cycle in the bog.

The circumference of the circle represents the boundary of atmosphere and water. From the atmosphere the bog receives Ca^{++} , Mg^{++} , Na^+ , NH_4^+ , N_2 , NO_3^- , SO_4^- , O_2 , CO_2 and Cl^- . The processes described above are described by lines and arrows in the figure; the Sphagnum is placed in the centre. From the above it also appears that the chloride-ion, while taken up by the Sphagnum (as may be shown by the ash-analysis) still remains as the biologically-stable component in the water. Due to its preponderance it will act as chief partner for the exchanged hydrogen ions, so that we are driven to the conclusion, mentioned before in this paper, that the reaction of the bog water is chiefly due to hydrochloric acid. As the water is unbuffered, a single rain-storm is sufficient to raise the pH! Presence of buffer (unless it be situated near the equilibrium-pH) might cause the death of the Sphagnum, in accordance with the observations of STELMACH (44) and SKENE (43). Photosynthesis seems most active in the emerged parts of the moss. The conduction of water (according to experiments by Dr W. BELJERINCK) seems to be downward, which seems to be in harmony with the findings of Miss BOWEN (9) for other mosses. While Sphagnum seems able to absorb moisture from the atmosphere, the amount taken up by this process seems hardly sufficient to saturate it fully with water.

A capillary film of liquid water has to be present at its exterior. Indications of a "vapour layer" from 5—10 cm above the bog could be obtained from atmometer-observations, although a definite proof is lacking. During the short period of our observations, no significant differences could be observed between water and air temperatures, although on top of the Sphagnum "cushions" very high temperatures have been recorded.

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THE CORNACEAE, SENSU STRICTO, OF THE NETHERLANDS INDIES

by

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After Mr. S. BLOEMBERGEN had planned a revision of the *Cornaceae*, *sensu amplissimo*, of the Netherlands Indies (inclusive those of the Malay Peninsula and the non-Dutch parts of Borneo and New Guinea) and had received, for that purpose, herbarium materials from different institutes, it appeared desirable to him to confine his revision to the *Alangiaceae*. I therefore took the *Cornaceae*, *sensu stricto*, for my account. It was very convenient to me that Mr. BLOEMBERGEN had already composed a nearly complete list of literature wanted.

The herbaria of which materials have been worked up in this revision, are the following.

B = Herbarium of the Botanic Garden, Buitenzorg, Java.

Be = Herbarium of the Botanic Garden, Berlin—Dahlem.

L = State Herbarium, Leiden.

S = Herbarium of the Botanic Gardens, Singapore.

U = Herbarium of the University, Utrecht.

I feel very thankful to the Directions of these herbaria for their kindness of sending me the materials on loan.

As a result of this revision I will mention in the following only 11 species as indigenous to the area accepted. This is due to the fact, that I thought it necessary to unite the many species mentioned for the area to a smaller number of polymorphic ones. No new species have been described, though several new varieties of *Mastixia tetrandra* had to be distinguished.

Moreover I am in doubt, whether the genus *Mastixiodendron* really belongs to this family.

Key to the genera.

Ovary inferior, one-celled. Calyx-lobes not deciduous.

Stipules none *Mastixia*, p. 47.

Ovary semi-inferior, two-celled. Calyx lobes deciduous.

Stipules large, interpetiolar, contort, deciduous... *Mastixiodendron*, p. 69.

MASTIXIA.

BLUME, Bijdr. Fl. Ned. Ind., 13, p. 654 (1825); D. C., Prodr., 4, p. 275 (1830); G. DON, Gen. Hist. Diehl. Pl., 3, p. 401 (1834); MEISN., Gen. pl., p. 153 (1838); ENDL., Gen. pl., p. 799 (1839); BLUME, Mus. Bot. Lugd. Bat., 1, p. 256 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 771 (1856); BAILLON, Adansonia, 5, p. 184 (1864—65); BENTH. & HOOK.F., Gen. pl., 1, p. 950 (1867); BAILLON, Hist. d. pl., 7, p. 255 (1879); CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 745 (1879); BOERL., Handl. Fl. Ned. Ind., 1, 2, p. 654 (1890); TRIMEN, Handb. Fl. Ceyl., 2, p. 286 (1894); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Booms. Java, 5, p. 86 (1900); SMITH, Bull. Inst. Bot. Buitenz., 11, p. 10 (1901); KING, Journ. As. Soc. Beng., 71, 2, p. 72 (1902); BRANDIS, Ind. trees, p. 356 (1906); WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 19 (1910); KOORDERS, Exkursionsfl. Java, 2, p. 730 (1912); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1916); RIDLEY, Fl. Mal. Pen., 1, p. 889 (1922); KOORD., Fl. Tjib., 2, p. 237 (1923); EVRARD, in LEC., Fl. Indo-Ch., 2, p. 1194 (1923); MELCHIOR, in ENGL., Jahrb., 60, p. 167, 171 (1925); *Mastixia* SPACH, Hist. Vég. Phan., 8, p. 88 (1839); *Bursinopetalum* WIGHT, Ic. pl., III, 3, p. 4 (1847).

The *Mastixiae* are trees of normal habit, with an erect, cylindric bole, that occupies about 0.6 of the total height of 10 to 35 m. The twigs and leaves are of medium or small, rarely rather large, dimensions. The flowers are disposed in triads (simple cymes) that are again united into more or less many-flowered corymbs. Dimensions and structure of the flowers show little variation. In the characters of the calyx tube, the corolla, the stamens, the style and the fruit I could not find differences for specific distinction. The differences that proved most valuable for that purpose are the following.

1. *The shape of the calyx teeth*, especially the relation between length and width. A part of the species have calyx teeth less than half as long as broad. There is some difference in this respect between the species of this group, but if in acuminate calyx teeth the acumen is excepted, and very young flower buds are left out of consideration, it is never doubtful whether a species is short- or long-toothed. The other species have calyx teeth, the length of which is at least $\frac{3}{4}$ of the breadth, usually, however, about as long as broad.

2. *The phyllotaxis*. There are species with the leaves spread and others with the leaves opposite. Though a sharp distinction of species,

by means of this character only, is not possible, it is a valuable distinction for determination. Species with opposite leaves often have, here and there, the leaves of one pair more or less remote from each other, and in very young specimens of *Mastixia trichotoma*, a species with normally opposite leaves, the leaves are entirely spread. Also it deserves mentioning, that I could not separate, as a species, *M. Margarethae*, with spread leaves, from *M. rostrata*, with opposite leaves. The difference in phyllotaxis causes moreover a difference in appearance of the young twigs and of the inflorescence, as opposite leaves cause strongly flattened internodes and pseudotrichotomous inflorescences, whereas in species with the leaves spread the twigs and inflorescences have not these characteristics.

3. *The 4- or 5-merous flowers.* It rarely occurs (as I sometimes saw in *M. philippinensis*), that in one inflorescence 4-merous and 5-merous flowers occur intermingled. Most species have the flowers either all of them 4-merous or all 5-merous. Yet the 4-merous species and the 5-merous species, each as a group, show no closer relation at all, and it is, therefore, quite incomprehensible, how WANGERIN could base subgenera on this difference. Between the 5-merous *M. korthalsiana* and the 4-merous *M. trichotoma*, there are no further differences at all, and the number of flower parts only I could not judge sufficient for specific distinction.

4. *The dimensions of twigs and leaves.* It is possible to distinguish certain species with very slender twigs and small leaves from others with coarse twigs and medium-sized or large leaves. *M. rostrata* and *M. bracteata* are, for instance, always typically slender and small-leaved, though in all other important characters they are different. Only in *M. trichotoma* I united the small-leaved slender *M. acuminatissima* and *M. clarkeana* with other, coarser and larger-leaved forms, as there undoubtedly exists a series of intermediate forms.

Key to the species.

- | | | |
|----|--|---------------------------------|
| 1a | Length of the calyx teeth at most one-half of their width... .. | 2 |
| b | Length of the calyx teeth at least three-quarters of their width, usually
the teeth as long as broad | 6 |
| 2a | Flowers 5-merous... .. | 3 |
| b | Flowers 4-merous... .. | 5 |
| 3a | Leaves spread; also the primary branches of the inflorescences spread | 4 |
| b | Leaves opposite or nearly so; inflorescence several
times trichotomous | 3. <i>M. kaniensis</i> , p. 51. |

- 4a Normal leaves not more than 6 cm long and 3.5 cm broad. Twigs slender. Lower branches of the inflorescences nearly 9-flowered 5. *M. bracteata*, p. 54.
- b Normal leaves 8—18 cm long, 3—9 cm broad. Twigs robust. Lower branches of the inflorescences nearly 27-flowered 1. *M. pentandra*, p. 49.
- c Cfr. also 6. *M. cuspidata*, p. 55.
- 5a Leaves opposite or spread, long-cuspidate, the cuspid 6—20 mm long, 1—1.5 mm broad, usually somewhat spatulate. Twigs slender 4. *M. rostrata*, p. 52.
- b Leaves spread, at most shortly acuminate. Twigs rather robust 2. *M. parvifolia*, p. 51.
- 6a Leaves spread. Primary branches of the inflorescences also spread 7
- b Leaves opposite or nearly so. Inflorescences several times trichotomous 9. *M. trichotoma*, p. 57.
- 7a Flowers 5-merous 7. *M. Scortechinii*, p. 56.
- b Flowers 4-merous 8. *M. totrandra*, p. 56.

1. *Mastixia pentandra* — A tree 12—34 m high, its bole 18—75 cm in diameter at a height of 1.5 m, 13—50 cm in diameter below the crown (according to herbarium labels). Twigs bearing adult leaves 2—6 mm thick. Leaves spread; petiole 10—45 mm long; lamina elliptic to oblong or more obovate, (5)8—18 cm long, (2)3—9 cm broad, contracted into the petiole below the rounded base or quite cuneate, with an obtuse cuspid up to 20 mm long 2—4 mm broad, thin-coriaceous, the secondary lateral nerves nearly transverse. Corymb with spread primary branches, usually three times branched below the triads; bracts of the lower branches usually linear, 5—15 mm long, obtuse, falling off during the development of the flowers, the upper ones shorter and narrower, remaining longer. Calyx limb nearly 1 mm long, cut halfway down into 5 very short and broad obtusely acuminate teeth. Style 0.5—1.5 mm long. Fruit ellipsoidal, often more or less ovate or obovate, 18—37 mm long, 15—17 mm in diameter, with differently developed disc. Indumentum silky in the young parts, none on the adult leaves and twigs, more densely and appressedly silky on the inflorescences towards the extremities and on the flowers, usually disappearing before the ripening of the fruit.

Mastixia pentandra BLUME, Bijdr., 13, p. 654 (1825); D. C., Prodr., 4, p. 275 (1830); G. DON, Gen. Hist. Diehl. Pl., 3, p. 401 (1834); HASSK., Cat. Pl. Hort. Bot. Bog., II, p. 168 (1844); BLUME, Mus. Bot. Lugd. Bat., 1, p. 256 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 771 (1856), p. 1095 (1858); suppl. Sum., p. 135 (1860); BAILLON, Adansonia, 3,

p. 83, nota (1862); TEYSM. & BINN., Cat. Pl. Hort. Bot. Bog., p. 169 (1866); ? CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 746 (1879) excl. synon.; HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Kenn. Booms. Java, 5, p. 88 (1900); ? GAMBLE, Man. Ind. Timb., ed. 2, p. 391 (1902); BRANDIS, Ind. trees, p. 356 (1906); MERRILL, Ann. Jard. Bot. Buitenz., suppl. 3, 1, p. 283 (1910) p. p.; WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 20, 26 (1910) excl. var. *cuspidata*; KOORD.-SCHUM., Syst. Verz., 1, fam. 229, p. 104 (1912) p. p.; KOORDERS, Exkursionsfl. Java, 2, p. 732, 734 (1912) p. p.; *Mastixia megacarpa* RIDL., Fl. Mal. Pen., 1, p. 891 (1922); *Mastixia Ledermannii* MELCHIOR, in ENGL., Jahrb., 60, p. 172, 173 (1926).

I have united *M. Ledermannii* and *M. megacarpa* with *M. pentandra*, as I could not discover sufficient differences. Perhaps *M. arborea* (WIGHT) CLARKE, and *M. philippinensis* WANGERIN, are only geographical variations of the same species. Sterile materials of *M. pentandra* I cannot distinguish from *M. tetrandra*, but as *M. tetrandra* is rare in the area dealt with, I reckoned such materials provisorily to *M. pentandra*.

MALAY PENINSULA. Penang: (locality illegible) HANIFF 3759 (S); Pulu Butong Reserve, 300 m, CURTIS 919 (S), type of *M. megacarpa* RIDL.; Pahang: Fraser Hill, 1200 m, NUR 11291 (S, B); Fraser Hill, southern slope, 1200—1350 m, BURKILL & HOLTUM 7840 (S).

SUMATRA. Palembang: Banjoe-Asin- & Koeboe-streken, 20 m, GRASHOFF 895 (B) v.n. *kajoe reboeng*; 15 m, Boschpr. bb. 158 E. 1 P. 850 (B, L) partly, cfr. *M. tetrandra*.

BORNEO. Eastern Part, near Long Petah, 450 m, ENDERT 3310 (B).

JAVA. "Harriang", VAN HASSELT (L) v.n. *tenjau*; without exact locality, for the greater part authentic specimens of *M. pentandra* BLUME, partly cultivated in the Buitenzorg Botanic Gardens, probably partly from the original locality, i. e. "Salak, Burangrang" (ex BL., l. c.); G. Boerangrang (B); G. Tangkoebanprahoe, KORTHALS (L); Pasocroean, Toerèn, Zuidergebergte near Soembertangkil, 400—500 m, KOORDERS 23785 β , forest number 305* (B, L); KOORDERS 23801 β , forest number 1547* (B, L).

NEW GUINEA. North-eastern Part, Etappenberg, 850 m, LEDERMANN 9575 (Be), type of *M. Ledermannii* MELCHIOR.

Sterile materials, perhaps partly *M. tetrandra*:

SUMATRA. Westkust: Oud-Agam, Bantjok Dalam, 900 m, boschproefstation bb. 7415 (B) v.n. *djao*; Bengkoeloe: Redjang, Kep. Tjoeroep, northern slope of Bt. Kaba, 1100 m, boschpr. bb. E. 1053 (B, L); Palembang: Moesi Ilir, Ipil, 9 m, boschpr. bb. TB. 1085 (B) v.n. *boeng*.

BANGKA. Rindik, 10 m, boscpr. bb 11581 (B) v.n. *mengkapas*.

BORNEO. South-eastern Part, Poeroek Tjahoe, Kp. Mocara Laoeng, 80 m, boscpr. bb 10028 (B) v.n. *pangoan poetih*; Boeloengan, near Salimbatoe, S. Pingping, 150 m, boscpr. bb. 11177 (B) v.n. *baer toas*, and S. Roemah, 150 m, boscpr. bb. 11180 (B).

2. ***Mastixia parvifolia*** — Twigs bearing full-grown leaves 1—2.5 mm thick. Leaves spread; petiole 5—13 mm long; lamina obovate or oblong-obovate, 2.5—5.5 cm long, 1.2—2.5 cm broad, cuneate at the base, shortly obtuse-acuminate at the apex, rather thickly coriaceous, with secondary lateral nerves not transverse and not distinguishable from the veins. Corymbs with spread primary branches, usually two or three times branched below the triads; lower branches in the axils of normal leaves, bracts unknown (fallen off in the materials available). Calyx limb with 4 very short teeth. Fruit (unripe) ovate-oblong, up to 20 mm long, 10 mm in diameter. Indumentum none (or already fallen off).

Mastixia parvifolia HALLIER, Beih. Bot. Centralbl., 34, 2, p. 41 (1916); MELCHIOR, in ENGL., Jahrb., 60, p. 172 (1925).

M. parvifolia is, with certainty, only known from the type materials, that are in fruit. Therefore we can say little about its affinities. The twigs and leaves resemble those of a small-leaved *M. pentandra*, as do the small calyx teeth, but the flowers are 4-merous. The small, hard leaves make it probable, that the type might be a mountain form of a more polymorphic species. Yet the further materials enumerated below are doubtful, especially those from Selebes. The specimen from Mt. Kinabalu is only a small fruit-bearing twig terminated by a short raceme of triads, but the leaves are up to 16 cm long, 7 cm broad.

BORNEO. G. Damoes, near the Nijoet, HALLIER B. 569 (B, L), type. Doubtful:

BORNEO. Mt. Kinabalu, Marai Parai, 1500 m, CLEMENS s. n. (B).

SELEBES. Southeastern Peninsula, Bt. Watoewila, 1500 m, KJELLBERG 1085 (B), "small tree".

3. ***Mastixia kaniensis*** — Internodes bearing full-grown leaves nearly 2.5 m thick in the lower part, up to 1.5 times as broad towards the top. Leaves opposite; petiole 7—13 mm long; lamina elliptic-oblong or somewhat obovate, 5—11 cm long, 1.5—4 cm broad, cuneate at the base, protracted in a 5—10 mm long, 1.5—3 mm broad cuspis, thin-coriaceous, with secondary lateral nerves distinct, transverse, somewhat arcuate. Corymbs 3—4 times trichotomous below the triads, the lower branches in the axils of normal leaves, the further bracts short, triangular, falling off after anthesis. Calyx limb nearly 0.75 mm long,

with 5 teeth that are short and broad, rounded with a very short acumen. Style nearly 0.75 mm long. Fruit unknown. Indumentum thin and silky on the young parts, soon falling off or remaining on the extremities of the inflorescences and on the flower buds.

Mastixia kaniensis MELCHIOR, in ENGL., Jahrb., 60, p. 172 (1925).

This species comes near to *M. pentandra* by its 5-merous flowers with short calyx teeth, but is different by the opposite leaves and consequently trichotomous inflorescences. The latter character is very striking and causes a resemblance with *M. trichotoma*, but I suppose that it is not of a great systematic value, and if this might be right the difference with *M. philippinensis* and *M. pentandra* would be unimportant.

NEW GUINEA. North-eastern part, Kani Mountains, 1000 m, SCHLECHTER 17061 (Be, type, L, cotype of *Mastixia kaniensis* MELCH.); *ibidem*, SCHLECHTER 17703 (L).

PHILIPPINE ISLANDS. Mindanao, Bukidnon, Mt. Candon, B. Se. 38841 (Be, L).

4. ***Mastixia rostrata*** — Tree, usually 10—28 m high, with a bole 20—50 cm in diameter at a height of 1.5 m (according to herbarium labels). Young internodes 1—2 mm thick at the base, up to 1.5 time as broad at the top. Leaves either opposite few of them spread, or all of them spread; petiole 8—12 mm long; lamina elliptic to oblong or somewhat obovate, 4—10 cm long, 1—4 cm broad, contracted below the rounded base or cuneate at the base, more or less abruptly cuspidate at the apex, with a cuspis 6—20 mm long, 1—1.5 mm broad, very obtuse, distinctly spatulate, thin-coriaceous, with secondary lateral nerves difficultly to be distinguished from the veins, not transverse nor arcuate. Corymbs rather small, 3—4 times trichotomous below the triads or the primary branches spread; all bracts small and acute. Calyx teeth 4, very short, rounded or very shortly acuminate. Style 1—2 mm long, rarely shorter. Fruit 15—20 mm long, 9—10 mm thick, ovate. Indumentum thinly to rather thickly silky, permanent on the extremities of the inflorescences, on the nodes, and on the underside of the petiole and the midrib.

Mastixia rostrata BLUME, Mus. Bot. Lugd. Bat., 1, p. 258 (1850); MIQ. Fl. Ind. Bat., I, 1, p. 773 (1856) & 1095 (1858); TEYSM. & BINN., Cat. Pl. Hort. Bot. Bog., p. 169 (1866); HARMS, in ENGL. & Pr., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Booms. Java, 5, p. 92 (1900); WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 20, 22 (1910); KOORD.-SCHUM., Syst. Verz., I, 1, fam. 229, p. 104 (1912);

KOORD., Exkursionsfl. Java, 2, p. 732, 734 (1912); KOORD. & VAL., Atlas, 1, tab. 191 (1913); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); MOLL & JANSSON., Mikrographie, 3, p. 729 (1918); RIDL., Fl. Mal. Pen., 1, p. 890 (1922) p.p.?²; *Mastixia Junghuhniana* MIQ., Pl. Jungh., p. 426 (1855); Fl. Ind. Bat., I, 1, p. 772 (1856); ? HARMS, in ENGL., Nat. Pflanzenfam., III, 8, p. 262 (1898); *Mastixia Margarethae* WANGERIN, in FEDDE, Repert., 4, p. 335 (1907); in ENGL., Pflanzenr., IV, 229, p. 20, 21 (1910); *Mastixia cuspidata* var. *Margarethae* HALLIER, Beih. Bot. Centralbl., 34, 2, p. 41 (1917); *Mastixia caudatifolia* MERRILL, Univ. Calif. Publ. Bot., 15, p. 233 (1909).

There are, indeed, small differences between the Java and Flores specimens with usually opposite leaves, described as *M. rostrata* and as *M. Junghuhniana*, and those from Sumatra and Borneo with spread leaves, and there are other small differences between the Sumatra specimens, described as *M. Margarethae* and the Borneo ones described as *M. caudatifolia*, but these differences appeared insufficient for specific distinction.

In ascribing a "drupa globosa" to *M. Junghuhniana*, MIQUEL was certainly in error; he might have described fruit-galls, as globose fruit-galls indeed occur in several *Mastixia* species.

CLARKE's *M. Junghuhniana* is *M. trichotoma*. RIDLEY's *M. rostrata* is certainly *M. trichotoma* for the greater part; perhaps MAINGAY's specimen cited by RIDLEY is right.

It is not clear how HALLIER, in his excellent publication on *Mastixia*, could take the 4-merous *M. Margarethae* as a variety of the 5-merous, insufficiently known *M. cuspidata*.

MALAY PENINSULA. Malacca, MAINGAY 709 (according to WANGERIN).

SUMATRA. Oostkust: near Badjalinggi, south of Tebingtinggi, 100 m, LÖRZING & JOCHEMS 7504 (= Deli-Proefstation 1380) (B); Westkust: on the Soengai Boeloe, 0 m, BECCARI P. S. 956 (L, type of *M. Margarethae* WANG.); Soeliki, near Moedik Iiki, 900 m, boschpr. bb. 3988 (B), v.n. *tapih* (?).

BORNEO. North Borneo: Mt. Kinabalu, Penibukan, 1200 m, CLEMENS 32101 (B); Elphinstone Prov., Tawao, ELMER 21584 (B, Be, S, U, co-types of *M. caudatifolia* MERR.) & ELMER 21870 (B, Be, S, U) second number cited by MERRILL; West Borneo: Long Hoet, 130 m, ENDERT 2577 (B); near the Kong Kemoel, 1600 m, ENDERT 4317 (B).

JAVA. Without exact locality: BLUME (U); "Progan" BLUME (L); JUNGHUHN (L, U, the former original of *M. Junghuhniana* MIQ.), v.n. *tjangkar*; Nirmala, native collector 193 (B) v.n. *daon kitadjas*; Nirmala,

Oetan Nangkok Botol, native coll. 41 (B) v.n. *daon kajoe tendjo*; G. Salak, 1000 m, KOORDERS 33268 β (B); near Kp. Bodjong, KOORDERS 24218 β , forest number 932* (B, L) v.n. *kitindjo, kitendjo*; G. Gedé, REINWARDT ?, houtsoort 645 (L) v.n. *kiboeray lalakina*; Takokak, forest G. Aseupan, KOORDERS 32860 β , forest number 1558* (B) v.n. *kitendjo*; Takokak, KOORDERS 9885 β , forest number 2090a (B) v.n. *kitendjo*; Takokak, 1050 m, KOORDERS 915 β (B, L) 11915 β (B, L), 11916 β (B, L), 25556 β (B, L), 32681 β (B), 37260 β (B), all with the forest number 2138a; KOORDERS 11917 β (B, Be, L, S, U) & 25634 β (B, Be, L) v.n. *kitendjo*, & 25735 β (B, Be, L) forest number 2309a; 25755 β (B, Be, L) v.n. *kilejas*; Pasir Padakati, 1035 m, KOORDERS 9901 β (B, L); Tjigenteng, KOORDERS 30123 β (B); Pasir Djamboe, 1400—1700 m, KOORDERS 26319 β , forest number 323* (B, L, S, U); Pengalengan, 1300 m, JUNGHUHN 168 (L, U, originals of *M. Junghuhniana* MIQ.); Pengentjongan near Garoet, 1400 m, KOORDERS 14081 β (B); Banjoemas. Pringombo, forest Grendeng, 800 m, KOORDERS 38076 β , forest number 157* (B, L); Pringamba, top G. Boetok, 1000 m, KOORDERS 39016 β , forest number 24* (B, L).

FLORES. Ende, Kp. Walo Lele, 1000 m, boscpr. bb. 12609 (B), v.n. *tapaaèkè*; Kp. Boa Feo, 900 m, boscpr. bb. 8922 (B, L) v.n. *raoe*, & bb. 8925 (B, L) v.n. *sje*.

5. ***Mastixia bracteata*** — Tree 12—16(—30?) m high, with a bole 15—20(—40?) cm in diameter (according to herbarium labels). Young internodes bearing full-grown leaves 1—1.5 mm thick at their base. Leaves spread; petiole 5—10 mm long; lamina elliptic to obovate or more oblong, 3—6 cm long, 2—3.5 cm broad, with cuneate base or contracted into the petiole below the rounded base, more or less abruptly acuminate, the acumen 5—10 mm long, 1.5—2 mm broad, obtuse, often more or less spathulate, thin-coriaceous, the secondary lateral nerves difficultly to be distinguished from the veins, indistinctly or rather distinctly transverse. Corymbs once or twice branched below the triads with spread branches; lower bracts leafy, either common small leaves, or lanceolate obtuse, gradually or more abruptly diminishing into the upper small triangular or more filiformous bracts. Calyx limb cupuliformous, with 5 short, broad teeth. Fruit not known. Indumentum rather densely silky in the young parts, appressed, less dense later, the leaves soon quite glabrous.

Mastixia bracteata CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 746 (1879); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KING, Journ. As. Soc. Beng., 71, 2, p. 73 (1902); WANGERIN, in ENGL.,

Pflanzenr., IV, 229, p. 20, 26, ic. 1, G—K, N—O (1910); RIDLEY, Fl. Mal. Pen., 1, p. 891 (1922).

Resembles *M. pentandra* by the short calyx teeth, is, however, quite different in general appearance, by the slender twigs and small leaves, which it has in common with *M. rostrata* and *M. trichotoma* var. *clarkeana*. I have not seen the type number MAINGAY 710, but I have seen the number KING's coll. 6830, cited by CLARKE.

MALAY PENINSULA. Perak: Larut, within 30 m, KING's coll. 6830 (B, Be, L); Malacca: Selandau, 0 m, HOLMBERG 840 (S), v.n. *dadaru*.

SUMATRA. Palembang: Banjoe-Asin- & Koeboe-streken, 5—20 m, boscpr. 68 T. 1 P. 124 (B, L), v.n. *k. koendoer* and *beboeng*.

BORNEO. Sarawak: BECCARI P. B. 1559 (B); Mt. Dulit, Ulu Tinjar, near Long Kapa, 700—900 m, RICHARDS 1966 (K) v.n. *biansu gunong*.

Without flowers, therefore uncertain:

BANGKA. Perlang, 5 m, boscpr. bb. 11638 (B), v.n. *mengkopas*.

BORNEO. Southern & Eastern Part: P. Tjahoe, Kp. Kalapeh, 200 m, boscpr. bb. 11064 (B) v.n. *mahawai aoe*; East Koctai, Sangkoelirang, Kp. Palawan, 50 m, boscpr. bb. 11963 (B).

6. ***Mastixia cuspidata*** — Young internodes bearing full-grown leaves 2—3.5 mm thick at their base. Leaves spread; petiole 6—9 mm long; lamina obovate-oblong, 7—12.5 cm long, 2.5—4.5 cm broad, cuneate at the base, abruptly acuminate at the apex, the acumen 6—18 mm long, 1.5—2.5 mm broad, sometimes slightly spathulate, thin-coriaceous, almost chartaceous, the secondary lateral nerves more or less distinctly arcuate. Corymbs 2 to 3 times branched below the triads, with spread branches. Bracts unknown. Calyx teeth 5, very short and broad. Fruit oblong, 22—23 mm long, 8—9 mm in diameter.

Mastixia cuspidata BLUME, Mus. Bot. Lugd. Bat., 1, p. 256 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 772 (1856), p. 1095 (1858); TEYSM. & BINN., Cat. Pl. Hort. Bot. Bog., p. 169 (1866); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40, 41 (1917) excl. var. *Margarethae*; ? DAKKUS, Bull. Jard. Bot. Buitenz., ser. 3, suppl. 1, p. 191 (1930); *M. pentandra* var. *cuspidata* WANG., in ENGL., Pflanzenr., IV, 229, p. 26 (1910).

Very incompletely known, the type specimens consisting of few leafy twigs with flowerless and fruitless inflorescences, and few detached, probably not yet ripe, fruit. By the 5 short calyx teeth, and the appearance of twigs and leaves it resembles *M. bracteata* more than any other species, but it is coarser in all parts and the leaves are more acuminate, whereas the bracts cannot be compared with those of that species. There is also a great resemblance with certain forms of *M. philippinensis*. The second

specimen, mentioned by HALLIER, is quite sterile, and may be as well *M. rostrata* as *M. cuspidata*.

SUMATRA. Probably Westkust: KORTHALS (L, U), originals of the species.

HALLIER reckons to this species also the following sterile specimen:

BORNEO. Bokit Kasian, AMDJAH (Exp. NIEUWENHUIS) 55 (B, L).

DAKKUS *l.c.* mentions *M. cuspidata* as cultivated in the Buitenzorg Botanic Gardens sub III. (t. 56 (not 56a), but I did not see any materials of this tree.

7. **Mastixia Scortechinii** — A small tree (ex KING). Young twigs 2—3 mm thick between the full-grown leaves. Leaves spread; petiole 8—15 mm long; lamina obovate to obovate-oblong, 4—9 cm long, 1.5—4 cm broad, acute at the base, acuminate at the apex, the acumen 5—12 mm long, obtuse but not spatulate, the secondary lateral nerves indistinctly transverse, not arcuate. Corymbs 3 to 4 times branched below the triads, with spread branches; bracts all triangular, small, acute. Calyx teeth 5, triangular, nearly as long as broad, acute or slightly acuminate. Fruit unknown. Indumentum on all young parts (probably) rather thinly but densely woolly-tomentose, later remaining only on the buds and nodes, partly also on the inflorescences, falling off from the twigs and leaves.

M. Scortechinii KING, Journ. As. Soc. Beng., 71, 2, p. 73 (1902); WANG., in ENGL., Pflanzenr., IV, 229, p. 21, 27 (1910); RIDLEY, Fl. Mal. Pen., 1, p. 891 (1922).

Of *M. Scortechinii* I only saw one twig in the Leiden and Berlin herbarium each, insufficient to make out whether this species, besides by the 5-merous flowers, is sufficiently different from *M. tetrandra* to be kept apart as a species.

MALAY PENINSULA. Perak: SCORTECHINI 1971 (Be, L, cotypes).

8. **Mastixia tetrandra** — Tree nearly 30 m high, with a bole 36—65 cm in diameter (according to herbarium labels). Young twigs bearing full-grown leaves 2—4 mm thick. Leaves spread; petiole 10—20 mm long; lamina obovate to obovate-lanceolate, 6—8 cm long, 2—4 cm broad, usually acute at the base, shortly and obtusely acuminate at the apex, rather thickly coriaceous, with secondary lateral nerves transverse, not arcuate. Corymbs nearly 4 times branched below the triads, with the primary branches spread; lower branches often in the axils of normal leaves, the further bracts small, acute, triangular. Calyx teeth 4, nearly as long as broad, subobtuse or somewhat acuminate. Fruit not known.

Indumentum almost none, or appressed grayish on the leaf- and flower-buds.

Mastixia lanceolata BAILLON, Andansoniana, 3, p. 83, nota (1862) nom. nud.; *Bursinopetalum tetrandrum* TEYSM. & BINN., Cat. Pl. Hort. Bot. Bog., p. 169 (1866) nom. nud.; *Mastixia tetrandra* CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 745 (1879) excl. var.; TRIMEN, Handb. Fl. Ceyl., 2, p. 287, t. 47 (1894) excl. var.; HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Booms. Java, 5, p. 88 (1900); WANG., in ENGL., Pflanzenr., IV, 229, p. 20, 21 (1910) excl. var.

This species is not distinguishable from *M. pentandra* in the sterile state, but is readily to be distinguished from it by the 4-merous flowers and long calyx teeth. Among the sterile specimens enumerated under *M. pentandra* there might be some of this species. The materials above mentioned quite agree with the type number THWAITES 2441, from Ceylon, in the Leiden Herbarium.

SUMATRA. Tapiannoeli: Angkola & Sipirok, near Kp. Sitoemba, 1440 m, boschpr. bb. 5229 (B, L) v.n. *modang ambogol*; Palembang: Banjoe-Asin- & Koeboe-streken, near Bajoeng Lintjir, 15 m, boschpr. bb. 158. E. 1 P. 850 as far as collected by ENDERT in April 1920, the further materials under the same number being *M. pentandra*; n.v. *reboeng*.

Cultivated in the Buitenzorg Botanic Gardens under III. G. 56a, non 56. Perhaps this is the specimen TEYSMANN & BINNENDIJK mentioned in their catalogue of 1866 as *Bursinopetalum tetrandrum*?

9. ***Mastixia trichotoma*** — Tree 12—40 m high, the bole 10—150 cm in diameter at a height of 1.5 m (according to herbarium labels). Internodes bearing full-grown leaves 1—10 mm thick in the lower part, up to 1.5 times as broad towards the apex. Leaves opposite or subopposite; petiole usually 10—30 mm long; lamina elliptic to lanceolate or ovate to ovate-lanceolate, usually 5—25 cm long, 2—11 cm broad, cuneate to rounded at the base and contracted into the petiole, acuminate, but not abruptly, the acumen 10—20 mm long obtuse or acute, thin-coriaceous or thick-chartaceous, the secondary lateral nerves distinctly transverse and somewhat arcuate. Corymbs usually 3 to 8 times trichotomous below the triads; lower bracts often more or less foliaceous or even common leaves, most or all of them, however, small, triangular, acute. Calyx lobes 4 or 5, triangular to ovate, often slightly acuminate. Style 0.5—1 mm long. Fruit ovate to oblong, 18—35 mm long, 7—15 mm thick. Indumentum either appressed and grayish, confined to the inflorescences and the young parts, or brownish and woolly, usually soon falling off,

more rarely persistent on the adult internodes and the undersides of the leaves.

Mastixia trichotoma BLUME, Bijdr. Fl. Ned. Ind., 13, p. 655 (1825); D. C., Prodr., 4, p. 275 (1830); G. DON, Gen. Hist. Diehl. Pl., 3, p. 401 (1834); HASSK., Cat. Pl. Hort. Bot. Bogor., II, p. 169 (1844); BLUME, Mus. Bot. Lugd. Bat., 1, p. 257, ic. 58 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 772 (1856) & p. 1095 (1858) cum var. *laxa*; BAILLON, Adansonia, 3, p. 83, in nota (1862); TEYSM. & BINN., Cat. Pl. Hort. Bot. Bogor., p. 169 (1866); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Booms. Java, 5, p. 90 (1900); WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 20, 24, ic. 1A—E (1910); KOORD.-SCHUM., Syst. Verz., I, 1, fam. 229, p. 105 (1912); KOORD., Exkursionsfl. Java, 2, p. 732, 734 (1912); KOORD. & VAL., Atlas, 1, tab. 190 (1913); KOORD., in ENGL., Jahrb., 50, suppl. p. 291, 293, 302 (1914); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); MOLL & JANS., Mikrogr., 3, p. 722 (1918); KOORD., Fl. Tjibod., 2, p. 238 (1923); BRUGGEM., Bull. Jard. Bot. Buitenz., ser. 3, 9, p. 199, 200 (1927); *Mastixia laxa* BLUME, Mus. Bot. Lugd. Bat., 1, p. 257 (1850) cum var. *angustifolia*; WANGER., in ENGL., Pflanzenr., IV, 229, p. 20, 24 (1910) cum var. *angustifolia*; KOORD., Exkursionsfl., 2, p. 734 (1912); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); *Mastixia acuminatissima* BLUME, Mus. Bot. Lugd. Bat., 1, p. 258 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 772 (1856) & 1095 (1858); suppl. Sum., p. 135 (1860); HARMS, in ENGL., Nat. Pflanzenfam., III, 8, p. 262 (1898); WANGER., in ENGL., Pflanzenr., IV, 229, p. 20, 22, ic. 1F (1910); *Mastixia kimanilla* BLUME, Mus. Bot. Lugd. Bat., 1, p. 258 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 772 (1856) & p. 1095 (1858) cum var. *caesia*; TEYSM. & BINN., Cat. Pl. Hort. Bot. Bogor., p. 169 (1866); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. Booms. Java, 5, p. 94 (1900); WANGER., in ENGL., Pflanzenr., IV, 229, p. 20, 25 (1910); KOORD.-SCHUM., Syst. Verz., 1, fam. 229, p. 104 (1912); KOORD., Exkursionsfl. Java, 2, p. 734 (1912); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); *Mastixia caesia* BLUME, Mus. Bot. Lugd. Bat., 1, p. 258 (1850); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); *Mastixia Maingayi* CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 746 (1879); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KING, Journ. As. Soc. Beng., 71, 2, p. 74 (1902) cum var. *sub-tomentosa*; WANGER., in ENGL., Pflanzenr., IV, 229, p. 20, 22 (1910); RIDLEY, Fl. Mal. Pen., 1, p. 890 (1922); *Mastixia Junghuhniana* CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 746 (1879) non MIQ.; *Mastixia Clarkeana* KING, Journ. As. Soc. Beng., 71, 2, p. 75 (1902) cum var. *macrophylla*; WANGER., in

ENGL., Pflanzenr., IV, 229, p. 20, 24 (1910) cum var. *macrophylla*; KOORD., Exkursionsfl. Java, 2, p. 734 (1912); RIDLEY, Fl. Mal. Pen., 1, p. 890 (1922) cum var. *macrophylla*; HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917) cum var. *macrophylla*; *Mastixia Korthalsiana* WANGER., in FEDDE, Repert., 4, p. 335 (1907); in ENGL., Pflanzenr., IV, 229, p. 20, 25 (1910); HALLIER, Beih. Bot. Centralbl., 34, 2, p. 40 (1917); *Mastixia propinqua* RIDL., Journ. Fed. Mal. States Mus., 4, p. 25 (1909); Fl. Mal. Pen., 1, p. 890 (1922); *Elataeriospermum Tokbray* KOORD., Junghuhn-Gedenkb., p. 173 (1910), non *Elateriospermum Tokbrai* BLUME; *Mastixia pentandra* KOORD.-SCHUM., Syst. Verz., I, 1, fam. 229, p. 104 (1912) p.p., non BLUME; *Vitex premnoides* ELMER, Leafl. Phil. Bot., 8, p. 2874 (1915); *Mastixia premnoides* HALLIER, Beih. Bot. Centralbl., 34, 2, p. 41 (1916); MERR., Phil. Journ. Sc., bot., 13, p. 43 (1918); Enum. Phil. Fl. Pl., 3, p. 242 (1923); MELCHIOR, in ENGL., Jahrb., 60, p. 172 (1925); *Mastixia rostrata* RIDL., Fl. Mal. Pen., 1, p. 890 (1922) non BLUME.

As is evident from the above list of synonyms, I take together, under the collective name of *M. trichotoma*, several forms, that by other authors are distinguished as different species. These forms, however, either show differences too slight for specific distinction, or are connected by intermediate forms.

Among the species distinguished by different authors, *M. trichotoma* BLUME (1825) is characterized by its middle-sized, elliptic to oblong leaves, the yellowish or ochraceous colour of its twigs and undersides of its leaves, the woolly indumentum covering all young parts, permanent on the inflorescences, the nodes and the undersides of the leaves.

BLUME himself split off from this species *M. lara* (1850), somewhat different by less branched inflorescences, larger flowers, and leaves that are only hairy on the underside of the nerves; moreover the leaves are a trifle smaller, more ovate, less acuminate, the inflorescences more densely woolly or nearly floccose.

Of this species BLUME distinguished a variety *angustifolia*, with leaves much smaller and less hairy, and inflorescences still less branched.

M. kimanilla BLUME (1850) has somewhat more ovate, quite glabrous leaves; the indumentum on the other parts is restricted to the young parts and the extremities of the inflorescences, and is more grayish and appressed, not brownish and woolly. Also the colour of different parts is more grayish.

M. caesia BLUME (1850) has blackish twigs and leaves that look somewhat pruinose, but this might be caused by the mode of drying.

For the remainder there is little difference with *M. kimanilla*, of which it can be hardly distinguished as a variety.

M. acuminatissima BLUME (1850) differs much more, and its specific distinction appears quite justified at first sight. Its twigs are more slender, its leaves smaller, more oblong, and long- and acute-acuminate; its colour is grayish, the indumentum grayish, appressed, and nearly restricted to the inflorescences, though also the buds and nodes are slightly hairy. This form, however, cannot be distinguished from *M. clarkeana* and is, together with this form, connected with *M. trichotoma* by intermediate forms.

M. Maingayi CLARKE (1879) is as well distinguished, at first sight, as *M. acuminatissima*, by copious ochraceous or even ferrugineous indumentum, that is permanent and dense on the inflorescences, twigs, petioles and undersides of the leaves; moreover are the leaves more coriaceous, more strongly nerved, and the midrib and primary and secondary lateral nerves are impressed above. The lower bracts of the inflorescences are common leaves or at least somewhat foliaceous, and gradually diminish into the upper small bracts. This remarkable form, however, is connected with *M. trichotoma* by intermediates, one of which was already described by KING as var. *subtomentosa*.

M. clarkeana KING (1902) is little different from BLUME's *M. acuminatissima*, but is quite conspicuous among the forms of the Malay Peninsula. If one would, in spite of the transition forms towards *M. trichotoma*, keep this form upright as a species, it would be impossible to keep it separated from *M. acuminatissima*. It has somewhat ovate, rather small, thin-coriaceous, quite glabrous leaves, somewhat larger and less acuminate than those of *M. acuminatissima*. The indumentum of the inflorescences is grayish and appressed.

M. korthalsiana WANGERIN (1907) is strikingly different by 5-merous flowers, hardly different, however, for the rest from forms such as *M. trichotoma* and *M. laxa* BLUME. It is remarkable that the materials of these form, distinguished by means of the 5-merous flowers only, and from distant localities, are so uniformous as to the characters of twigs and leaves, but so different as to the dimensions of the fruit.

M. korthalsiana var. *macrophylla* WANGERIN (1907) is, as HALLIER already remarked, not 5-merous but 4-merous, and nothing but a large leaved form of *M. clarkeana*, so connecting this with larger-leaved forms of *M. trichotoma*.

M. propinqua RIDLEY (1909) is intermediate between *M. clarkeana*

and *M. trichotoma*; it has the general appearance of the latter but the appressed grayish indumentum of the former.

M. premnoides (1915) is an analogous form, but somewhat more yellowish-coloured and with a more loose indumentum.

Among the materials at my disposition I moreover found forms, that as well as several of the above-mentioned ones, deserve distinction as varieties. I am quite well aware, that it is rather arbitrary how many varieties may be named as such; but as on one hand I thought it undesirable to let forms as *M. Maingayi*, *M. acuminatissima* and my new variety *simalurana*, unnamed, and on the other hand the distinction of varieties is a means by which the polymorphy of a species may be more distinctly expressed, I have described, in the following, as many as 9 varieties. Besides these, there remain several, more or less intermediate, forms unnamed.

Of the varieties described, the var. *laxa* may be considered as the central type, from which the other varieties diverge in different directions. It is connected by the var. *benculuana* with the extreme var. *simalurana*; in this direction the variability is characterized by the increasing dimensions of all vegetative parts, and of the indumentum, which, however, is shorter and more papillose than that of the var. *Maingayi*. The var. *laxa* is connected with the extreme var. *Maingayi* by such forms as indicated in the distribution list as *sub-Maingayi*, and among which is *M. Maingayi* var. *sub-tomentosa* KING. The var. *Maingayi* is characterized by more copious velvety indumentum and thicker leaves with stronger nerves impressed on the upper surface. To the connecting forms the var. *benculuana* is rather similar. By forms indicated by the name *sub-clarkeana* and *clarkeana* the central type *laxa* is connected with the extreme var.s *acuminatissima* and *tenuis*. In this series of varieties the dimension of vegetative parts are decreasing, the twigs become very slender, the leaves thin and small, the indumentum gray and appressed. The var.s *korthalsiana* and *rhynhocarpa* are no extreme forms; from the var. *laxa* they are distinguished each by one striking character, the former by 5-merous flowers, the latter by peculiarly rostrate fruit.

The varieties distinguished here are the following:

1. Var. **tenuis** nova var.; arbor ad 25 m alta, altitudine 1.5 m 40 cm diametro; internodia foliifera parte inferiore 1—3 mm crassa; petiolus 5—16 mm longus; lamina 4—9 cm longa, 2—4 cm lata, ovata vel elliptica vel nonnihil oblongior, acumine distincto vel conspicuo, 5—12 mm longo, 3—4 mm lato, obtuso, non spathulato, tenuiter coriacea vel chartacea. Corymbi minores vel parvi, sub triadibus ter vel quater

trichotomi; bracteae inferiores nonnunquam foliaceae, plerumque petiolaceae acutae ad 4 mm longae, superiores minores triangulares acutae, tempore fructificationis maxima parte deciduae; flores 4-merae; fructus (maximi noti) 14—15 mm longi, 6—7 mm diametro, ovati, calycem versus paulum acutae; indumentum canum adpressum, ad inflorescentias ramulos petiolos nervosque crassiores juveniles restrictum, denique in omnibus partibus deciduum.

Distribution: Sumatra, Borneo.

2. Var. **acuminatissima** nov. var.; arbor magnitudine ignota; internodia foliifera parte inferiore 1.5—2 mm crassa; petiolus 10—15 mm longus; lamina 7—12 cm longa, 2—3.5 cm lata, lanceolata vel ovato-lanceolata, tenuiter coriacea vel chartacea acumine 12—20 mm longo apicem versus sensim attenuato acuto vel acutiusculo; corymbi sub triadibus ter trichotomi; bracteae non foliaceae, omnes parvae triangulares acutae, mox deciduae; flos statu alabastri adulti 3—3.5 mm longus, 4-merae; fructus ignotus; indumentum adpressum canum, in inflorescentiis floribus petiolis internodiisque juvenilibus, iam tempore florendi parte deciduum.

Mastixia acuminatissima BLUME, Mus. Bot. Lugd. Bat., 1, p. 258 (1850).

Distribution: Sumatra.

3. Var. **clarkeana** nov. var.; arbor (ex singula schedula) ad 37 m alta, trunco altitudine pectoris ad 76 cm diametro; internodia foliifera parte inferiore 1—3 mm crassa; petiolus 6—20 mm longus; lamina 7—17 cm longa, 1.5—8 cm lata, ovato-oblonga ad lanceolata, chartacea vel tenuiter coriacea, acumine distincto apicem versus sensim attenuato, 5—15 mm longo 2—4 mm lato, plerumque obtuso raro subspathulato; corymbi sub triadibus quater vel quinquies trichotomi; bracteae inferiores magis vel minus foliaceae saepe folia normalia parva, abrupte in superiores parvas acute triangulas plerumque iam tempore florendi deciduas transientes; flos statu alabastri adulti 2—3 mm longus, 4-merae; fructus quoad notus (ex speciminibus non typicis) ovato-oblongus vel angustior, ad 30 mm longus 10 mm diametro; indumentum canum adpressum in inflorescentiis, floribus, petiolis, foliorumque nervis crassioribus, mox deciduum, iam tempore florendi in extremitatibus inflorescentiarum tantum permanens.

Mastixia clarkeana KING, Journ. As. Soc. Beng., 71, 2, p. 75 (1902) an cum var. *macrophylla*?

Distribution: northern parts of the area of the species, Sumatra, Bangka, Malay Peninsula, North Borneo.

Specimens indicated by me in the distribution lists as *sub-clarkeana* are those forms, that belong to *clarkeana* as to the indumentum, but that have coarser twigs and larger leaves, or that verge towards the var. *laxa* by looser indumentum on the nodes and more brownish hue of the twigs and undersides of the leaves; among these is the form described by RIDLEY as *M. propinqua*.

4. Var. ***laxa*** MIQUEL; arbor ad 28—30 m alta, trunco pectoris altitudine 40 cm diametro; internodia foliifera parte inferiore 2—7 mm crassa; petiolus 8—24 mm longus; lamina 4—20 cm longa, 2—8 cm lata, tenuiter coriacea, elliptica vel ovata ad oblonga vel ovato-oblonga, acumine valde variabili, brevi vel longo, obtuso vel acuto, nunquam tamen spathulato; corymbi sub triadibus quater vel quinquies trichotomi; bracteae non foliaceae, omnes parvae acutae triangulares, inferiores iam ante tempus florendi deciduae; flos statu alabastri adulti 3—3.5 mm longus, 4-meres; fructus 20—30 mm longus, 9—13 mm diametro, ovatus; indumentum fuscum vel ochraceum, saepe floccosum in omnibus partibus iuvenilibus, tempore florendi in floribus et extremitatibus inflorescentiarum, in petiolis et in facie inferiore nervorum crassiorum, raro etiam parcum in laminae facie inferiore.

Mastixia trichotoma BLUME, Bijdr., 13, p. 655 (1825); *M. trichotoma* & *M. laxa* cum var. *angustifolia* BLUME, Mus. Bot. Lugd. Bat., 1, p. 257, ic. 58 (1850); *M. trichotoma* MIQ., Fl. Ind. Bat., I, 1, p. 772 (1856) & p. 1095 (1858) cum var. *laxa*.

Distribution: Java.

5. Var. ***korthalsiana*** nov. var.; arbor 12—25 m alta, trunco altitudine pectoris 10—60 cm diametro; internodia foliifera parte inferiore 1—5 mm crassa; petiolus 10—17 mm longus; lamina 5—16 cm longa, 2—5.5 cm lata, chartacea vel tenuiter coriacea, elliptica ad oblongo-lanceolata, raro paulum ovata, acumine valde protracto 5—20 mm longo 2.5—5 mm lato obtuso sed nunquam spathulato; corymbi statu fructifero tantum noti, sub triadibus quater vel quinquies trichotomi, bracteis ignotis tempore fructificationis iam deciduis; flos 5-meres; fructus oblongo-ovatus, 20—32 mm longus 8—14 mm diametro; indumentum fuscum floccosum in omnibus partibus iuvenilibus, postea in nodis ramulorum et inflorescentiarum tantum permanens.

M. Korthalsiana var. *typica* WANGERIN, in FEDDE, Repert., 4, p. 335 (1907).

Distribution: South-Sumatra, South-Borneo.

6. Var. ***Maingayi*** nov. var.; arbor 20—40 m alta, trunco altitudine pectoris c. 40 cm diametro; internodia foliifera 2—5 mm crassa; petiolus

10—20 mm longus; lamina crassiuscule coriacea, nervis lateralibus primariis et secundariis facie superiore impressis, 10—20 cm longa, 4—9 cm lata, ovata ad ovato-oblonga, rarius elliptica ad lanceolata vel angustior, acumine plerumque ad 10 rarius ad 20 mm longo obtuso, nunquam tamen spathulato; corymbi sub triadibus quinquies vel sexies trichotomi; bracteae inferiores plerumque foliis normalibus similes vel magis minusve foliaceae, superiores vario modo diminutae, ad tempus fructificationis permanentes; flos 4-merus, statu alabastri adulti 2.5—3.5 mm longus; fructus ovatus, 18—20 mm longus, 10—13 mm diametro; indumentum dense velutinum in omnibus partibus iuvenilibus, in inflorescentiis adultis ramulis petiolis faciebusque inferioribus foliorum tantum permanens.

Mastixia Maingayi CLARKE, in HOOK.F., Fl. Br. Ind., 2, p. 746 (1879).

Distribution: around the Malacca and Karimata Straits, i.e. southern and western coast of the Malay Peninsula, eastern coast of Sumatra, Bangka, western coast of Borneo.

7. Var. **benculuana** nov. var.: arbor 21—28 m alta, trunco ad 45 cm diametro; internodia foliifera parte inferiore 3—5 mm crassa; petiolus 17—35 mm longus; lamina 10—20 cm longa 4—8 cm lata, crassiuscule coriacea, nervis lateralibus primariis tantum impressis, ovato-oblonga, rarius elliptica vel oblonga, acumine 7—12 mm longo obtusiusculo vel acutiusculo; corymbi sub triadibus quater vel quinquies trichotomi, bracteis omnibus parvis, inferioribus iam ante anthesin deciduis; flos 4-merus, statu adulto ignotus; fructus 25—30 mm longus, 14—16 mm diametro; indumentum papillosum vel nonnihil velutinum, fuscum, diu permanens etiam in ramulis, in petiolis nervis crassioribus et inter nervos facie inferiore, denique iam parcissimum iam densiusculum.

Distribution: Korinchi Peak and Bencoolen.

8. Var. **rhynchocarpa** nov. var.: arbor 20—25 m alta, trunco 25—40 cm diametro; internodia foliifera parte inferiore 2—4 mm crassa; petiolus 10—18 mm longus; lamina tenuiter coriacea, 9—16 cm longa, 3—7 cm lata, elliptica ad oblonga vel nonnihil ovata, acumine protracto 8—16 mm longo acuto vel obtuso, non spathulato; corymbi sub triadibus e. quater trichotomi; bracteae omnes parvae acutae, inferiores 2—5 mm longae superiores gradatim decrecentes; flos 4-merus, statu adulto ignotus; fructus immaturus tantum notus, disco inflato 4-tuberculato et stylo in rostrum 2—3 mm longum acuto coronatus; indumentum fuscum papillosum vel saltem breve, in omnibus partibus iuvenilibus densum, mox tenuescens, in foliorum facie inferiore denique deciduum.

If the beak on the fruit might prove to be a deformity, this variety would hardly differ from the var. *benculuana*.

Distribution: Central Borneo.

9. Var. **simalurana** nov. var.: arbor 18—21 m alta, trunco c. 16 m alto, pectoris altitudine 50—150 cm diametro (sic!); internodia foliifera parte inferiore 4—10 mm crassa; petiolus ad 32 mm longus; lamina 7—25 cm longa, 3—12 cm lata, crassiuscule coriacea, ovato-oblonga, acumine 5—20 mm longo obtusiusculo; corymbi in paniculas uniti, sub triadibus sexies vel pluries trichotomi; bractae omnes parvae triangulae acutae vel inferiores folia normalia; flos 4-meres, adultus 2.5—3 mm longus; fructus 20—35 mm longus, 10—15 mm diametro; indumentum fuscum breve adpressum vel papillosum, in omnibus partibus juvenilibus densum, mox tenuescens, in ramulis diu permanens, in petiolis et in foliorum nervis crassioribus et etiam inter nervos facie inferiore breve sed subdensum.

Distribution: Island Simeuloeë (Simaloer).

In the following distribution list of the species I have indicated the varieties by bold-faced capitals, being the initial ones of the variety names. So **A** = var. *acuminatissima*, **B** = var. *benculuana*, **C** = var. *clarkeana*, **K** = var. *korthalsiana*, **L** = var. *laxa*, **M** = var. *Maingayi*, **R** = var. *rhynchocarpa*, **S** = var. *simalurana*, **T** = var. *tenuis*.

MALAY PENINSULA. Without exact locality: MAINGAY, Kew distribution 711 (Be, L) **M**; Penang: Government Hill, 360 m, CURTIS 1564 (S) **M**; Perak: SCORTECHINI 98 (Be) **C**; 625b (B, S) **C**; 869 (L) **C**; the Cottage, CURTIS 3575 leg. FOX (S), v.n. *kayu neiri* **L**; Pahang: Telom, RIDLEY 13899 (S), type *M. propinqua* RIDL. **sub-C**; Selangor: Sungei Lalang Kajang, SYMINGTON 22615 (S) **C**; Malacca: Sungei Udang, 0 m, DERRY 584 (S) v.n. *kayu mawa* & 1036 (S) v.n. *kayu bengkal bukit*, **sub-M**; Singapore: CANTLEY's collector s.n. (S) **M** & ?.

SIMEULOEË. ACHMAD 109 (B, L), v.n. *ahelat*, 500 (B, L, U) v.n. *awa simangoerah*, 510 (B, L, U) *awa ahelat oeding*, 588 (B, L, U) v.n. *awa enti*, 696 (B, L) v.n. *ahelat oeding*, 1183 (B, L) v.n. *toetoen simangoerah pajo*, all **S**.

SUMATRA. Without exact locality: PRAETORIUS (L, U), authentic specimens of *M. acuminatissima* BLUME, **A**; Oostkust: Karolanden near Kp. Tongka, 1456 m, boscpr. bb. 6234 (B), v.n. *damar* ?; Westkust: G. Singgalang, BECCARI P.S. 46 (L) var. ?; Pajakoemboeh, Kp. Oeloe Air, 1240 m, boscpr. bb. 6710 (B), v.n. *kiauw*, **T**; Oud-Agam, Kp. Paoeh, 1300 m, boscpr. bb. 2932 (B, L) v.n. *madang toendjoek*, **C**; Oud-Agam, S. Dareh near Kp. Batas Tjoeli, 1200 m, boscpr. S.W.K. II. 27 (B), v.n. *madang toendjoek*, var. ?; Oud-Agam, Kp. Mahalak, 1000 m, boscpr. bb. 6666 (B), v.n. *djao* **M** ?; Solok, near Kp. Loeboekselasih, 1000 m, boscpr. 5499 (B, L) v.n. *koendoer (djanten)*, var. ?; G. Kerintji, 2000 m,

BÜNNEMEYER 9572 (B, S), **B**; Bengkoeloe: Redjang, Bt. Kaba, boschpr. bb. 2254 (B, L), v.n. *boeng*, **B**, & bb. 2255 (B, L) v.n. *tanah*, **B**; Redjang, Rimba Air Tidatar, boschpr. bb. 2446 (B, L) v.n. *medang timu*, **B**; Redjang, Taba Penandjoeng, boschpr. bb. 2286 (B, L) v.n. *medang djentik*, var. ?; Kroë, Kota Banglai, 900 m, boschpr. bb. 10297 (B) v.n. *kembang tjangké*, var. ?; Palembang: Kp. Ning, R. Bliti, 150 m, H. O. FORBES 2744 (Be, L, S) **K**; Lematang Oeloe, 150 m, LAMBACH 1261 (B, L) v.n. *medang kladi*, **K**; Pasemah-landen, Pg. Tjawang Tjempedak, marga Lb. Boentak, 1200 m, boschpr. T. B. 208 (B) v.n. *kemoeran*, **T**; Lematang Ilir, 75 m, boschpr. 98 T. 3 P. 261 (B, L), v.n. *kapoer*, **M**.

BANGKA. Pangkal Pinang, TEYSMANN (B), **C**; Muntok, Air Limau, boschpr. bb. 7826 (B) v.n. *mentepong*, **M**; Rindik, 10 m, boschpr. bb. 11578 (B) v.n. *menamer*, **M**.

BELITTOENG. Tandjoeng Pandan, near Kp. Bantan, 30 m, boschpr. bb. 9171 & 10237 (B), v.n. *mendamaran*, var. ?.

BORNEO. Sarawak: native collector 1856 (L) **C**; Kuching, GARAI (HAVILAND) 957 (S, Sa) **C**; Kuching, HAVILAND & HOSE 3625 E (L) **C**; West Borneo: Kapoeas, TEYSMANN 8379 H. B. (B) v.n. *imoer-imoer*, **M**; G. Kenepai, HALIER B 1836 (B, L), **T**; East Borneo: Boeloengan, Selimbatoe, near Kp. Roehmah, 100 m, boschpr. bb. 11287 (B), v.n. *oeras-oeras goenoeng*, var. ?; near Long Petah, 450 m, ENDERT 3429 & 3465 (B), **K**; near Long Hoet, 150 m, ENDERT 4769 & 2572 (B) **R**; South Borneo: without exact locality, KORTHALS (B, L), in (L) authentic specimens of *M. korthalsiana* var. *typica* WANG., **K**. & of var. *macrophylla* WANG., sub-**C**; G. Sakoembang & G. Balaran, KORTHALS (L), authentic specimens of *M. Korthalsiana* var. *typica* WANG., **K**; lower Dajak-River, Kp. Teroesan, 1 m, boschpr. bb. 9888 (B), v.n. *kamoeran*, var. ?.

JAVA. Without exact locality: REINWARDT (B, L, U), authentic specimens of *M. kimanilla* BLUME, v.n. *kimanilla*, **C—L**; REINWARDT, houtsoort no. 125 (L) v.n. *plaglar minjak*, var. ?; BLUME (Be, L, U), authentic specimens of *M. trichotoma* BLUME, **L**; BLUME (B, Be, L), authentic specimens of *M. laxa* BL., **L**; BLUME, "*Mastixia trichotoma, stirps junior*" (L), var. ?; "Harriang", VAN HASSELT (L, U), v.n. *tenggau*, var. ?; Banten: VAN HASSELT (L), authentic of *M. caesia* BLUME, **C—L**; G. Poeloesari (near Pandeglang) (B, L), authentic of *M. laxa* var. *angustifolia* BL., **L**; G. Poeloesari, above Doekoeh Tjihoedjan, KOORDERS 913 β , forest number *9 (B), var. ?; G. Poeloesari, 1050 m (?) (KOORDERS 914 β , forest number *8 (B, Be, L, U), **L**; Dépok, 95 m, BURCK & DE MONCHY (B), var. ?; Tjiampèa near Buitenzorg, 200—300 m, KOORDERS 30598 β , forest number 486* (B, L), var. ?; KOORDERS 30597 β , forest number 1548*

(B), **L**; G. Salak, BLUME (L), authentic of *M. laxa* and of *M. trichotoma* BL., v.n. *kibunting*, **L**; G. Salak, near Kp. Bodjong, 600—1000 m, KOORDERS 24478 β , forest number 930* (B), v.n. *kendoe*, **L**; near Kp. Bobodjong, 800 m, KOORDERS 24459 β , forest number 158* (B, L), **L**; G. Gedé, 600—1200 m, JUNGHUHN (L), var. ?; G. Gedé, REINWARDT?, houtsoort no. 47, v.n. *kidedak*, var. ?, 227, v.n. *kibenteli*, var. ?; 652, v.n. *kilangseb lalakina*, var. ?; Tjibodas, tree no. 3100a, KOORDERS 32188 β (B), 41829 β (B), 13231 β (B, L), v.n. *kibonteng*, var. ?; tree 3168a, KOORDERS 25909 β (B, L), 2200 β (B), 12487 β (B, L), 41874 β (B), 25860 β (B, L), 2191 β (B, L), v.n. *mehmal*, *memah*, *hoeroe mehmah*, **L**; SAPIIN 2599 (B) **L**; Takokak, G. Aseupan, KOORDERS 25680 β (B), v.n. *kimenjan*, var. ?; Takokak, KOORDERS 15227 β , forest number 2412a (B, Be, L) v.n. *kitendjo*, var. ?; Tjidatoe near Soekaboemi, 900 m, KALSHOVEN VII (B, L), v.n. *djerèt*, **L**; Bodjong Genteng, near Tjissalak, 500 m, KOORDERS 39459 β , forest number 45* (B, L), **sub-C**; G. Bèsèr, south of Tjibeber, 1000 m, WINCKEL 264 β (B, L), v.n. *hoeroe hiris*, **L**, 289 β (B, L, S, U) v.n. *hoeroe minjak*, **L**; G. Boerangrang, BLUME (B), authentic of *M. laxa* BL., **L**; G. Papandajan, KORTHALS (L), **L**; Pasir Djamboe, Tjigenteng, 1400—1700 m, KOORDERS 26248 β , forest number 321* (B, Be, L), v.n. *kiloengloem*, **L**; G. Tjigoeloedog, near Bandoeng, 1050 m, boschpr. Ja. 1368 (B), v.n. *kiloemloem*, var. ?; Pengalengan, 1200 m, JUNGHUHN (L), var. ?; Noesagedé, in the Pendjaloe Lake, 720 m, KOORDERS 47885 β , forest number 341 (B), youth form with partly spread leaves, var. ?; 47886 β , forest number 530 (B), very young form with spread, dentate leaves, var. ?; G. Slamet, KOORDERS 9980 β , forest number 23 (B), var. ?; G. Slamet, DEN BERGER 122 (B, L), v.n. *woeroe*, **sub-C**; forest Mantrem near Ngasinan (Magelang), KOORDERS 27699 β , forest number 879* (B, L), v.n. *woeroe sonten*, L; G. Oengaran, Medini, 900—1200 m, JUNGHUHN (L), v.n. *lawean*, “*Plantae Junghuhnianae ineditae*” 86, *Elaterospermum Tokbraj* KOORD., non BL., var. ?; Pasoeroean, G. Kidoel, forest Soembertangkil, 400—500 m, KOORDERS 23754 β , forest number 1252* (B, L), var. ?; Ragadjampi (Besocki), KOORDERS 28894 β , forest number 1356* (B, Be, L), **L**.

SELEBES. Menado, near Kp. Klabat, 340 m, boschpr. bb. 14153 (B), **sub-C**; foot of G. Klabat, 600 m, KOORDERS 16977 β , forest number 717 (B), v.n. *makolimboen*, var. ?; near Loebœ, KOORDERS 17519 β , forest number 2226 (B), v.n. *aloechéra*, & 17518 β , forest number 2257 (B), v.n. *kajoe tondongan*, var. ?; forest Loelomboelan near Pakoe-oéré, 700 m, KOORDERS 17474 β , forest number 3308 (B), v.n. *sansalan*, var. ?; Kp. Klabat, 340 m, boschpr. 14155 (B), var. ?.

AMBON. Doesoen Poeta, Kp. Hatoe, 300 m, boscpr. bb. 14267 (B), v.n. *mameleng hoetan*, **sub-C**.

PHILIPPINE ISLANDS. Mindanao: Davao, Todaya, ELMER 11644 (B), cotype of *Vitex premnoides* ELM., **sub-C**; Lake Lanao, Camp Keithley, CLEMENS s.n. (Be), var. ?.

Species dubia.

Mastixia gracilis KING, Journ. As. Soc. Beng., 71, 2, p. 73, 74 (1902); WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 21, 28 (1910); RIDLEY, Fl. Mal. Pen., 1, p. 891 (1922).

“A small tree; young branches slender, angled, smooth, yellowish. *Leaves* thinly coriaceous, lanceolate, tapering much to the base and still more to the much acuminate apex; both surfaces pale olivaceous-green when dry, glabrous; the upper shining, the lower somewhat dull; main-nerves 8 to 14 pairs, ascending, very little curved, faint on both surfaces; length 2.25 to 4.5 in.; breadth .8 to 1.5 in.; petioles varying from .2 to .25 in. *Cymes* in threes, terminal, about a third or a fourth the length of the leaves, on short angled peduncles, the branches short and crowded at their apices, many flowered, with a whorl of minute broad bracts at the base of flower pedicels. *Flowers* about .1 in. long, their pedicels about as long, ovoid. *Calyx* campanulate; the tube puberulous, slightly furrowed; the mouth wavy, indistinctly 5-toothed. *Petals* 5, oblong-ovate, adherent by their edges, concave, leathery. *Stamens* 5; *anthers* oblong, bifid: filaments short. *Disc* small. *Style* short, conical: stigma concave. *Fruit* unknown.”

“PERAK: at an elevation of about 5,000 feet; Wray 1528.”

It seems to be unknown where the type specimen of this plant actually is. Neither WANGERIN nor RIDLEY did see it. The description does not convince me, that it really is a *Mastixia*.

Species reiciendae.

Mastixia ? cuneata BLUME, Mus. bot. lugd. bat., 1, p. 257 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 773 (1856) & 1905 (1858); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); KOORD. & VAL., Bijdr. booms. Java, 5, p. 87 (1900); WANGERIN, in ENGL., Pflanzenr., IV, 229, p. 29 (1910).

According to KOORDERS & VALETON, *l.c.*, this is no *Mastixia* and probably no *Cornacea*. According to WANGERIN *l.c.* it is a species excludenda, “ex anatomia foliorum *Embelia* spec.” According to HALLIER, in Beih. Bot. Centralbl., 34, 2, p. 42 (1916) it is *Notaphoebe umbelliflora* BLUME.

Mastixia? heterophylla BLUME, Mus. bot. lugd. bat., 1, p. 257 (1850); MIQ., Fl. Ind. Bat., I, 1, p. 773 (1856); suppl. Sum., p. 136 (1860); HARMS, in ENGL. & PR., Nat. Pflanzenfam., III, 8, p. 262 (1898); WANGERIN, in ENGL., Pflanzenr., IV., 229, p. 28 (1910); HALLIER, Meded. Rijks Herb. Leiden, 36, p. 5 (1918).

According to WANGERIN *l.c.* this is a "species valde dubia". According to HALLIER *l.c.* it is *Gomphandra capitulata* BECC.

MASTIXIODENDRON.

MELCHIOR, in ENGL., Jahrb., 60, p. 167 (1925).

Only species:

Mastixiodendron pachyclados (K. SCHUM.) MELCH.; *Fagraea pachyclados* K. SCHUM., in SCHUM. & LAUTERB., Nachtr. Fl. deutsch. Schutzgeb. Südsee, p. 349 (1905); *Mastixiodendron pachyclados* MELCHIOR, in ENGL., Jahrb., 60, p. 168, t. 1 (1925); LAUTERB., in ENGL., Jahrb., 63, p. 467 (1930); C. T. WHITE, Journ. Arnold Arbor., 10, p. 257 (1929).

As to the treatment of this genus by MELCHIOR *l.c.* I can add hardly anything of importance, I will confine myself to some remarks, the more as I am in doubt, whether *Mastixiodendron* really has to be placed among the *Cornaceae*. More probable seems to me, that it might be a *Rubiaceous* genus, and this because of the following considerations.

The supposition that *Mastixiodendron* might be a *Rubiacea*, was awaked in me by the general appearance of the plant, and in the first place by the occurrence of large interpetiolar stipules. When we ask ourselves, why MELCHIOR does not place *Mastixiodendron* among the *Rubiaceae*, we must come to the conclusion, that this is only because of the choripetalous corolla. Therefore I have tried to settle, whether the corolla of *Mastixiodendron* really is choripetalous, but I found, that of all materials in the Berlin Herbarium the corollas were too little developed, to establish this with certainty. From the drawings given by MELCHIOR, appears, that nor the author of the genus himself saw better-developed corollas.

When we try to determine the plant with THONNER's determination key and with ENGLER & PRANTL's Pflanzenfamilien, supposing that the corolla is sympetalous, we do not only come to the *Rubiaceae*, but even without difficulty to the genus *Plectronia*, of which there occur many species in New Guinea. In the treatment of the New Guinea species of this genus by VALETON in ENGLER's Jahrbücher (61, p. 53), I did not succeed, however, in finding a species strongly resembling *Mastixiodendron*.

Anyhow, it seems to me that more attention has to be paid to the peculiar characters of the stipules of this genus. MELCHIOR mentions them, but does not describe them as interpetiolar, nor does he mention the remarkable scars they leave on the twigs nor their contort aestivation. Besides in some genera of *Rubiaceae* (e.g. *Sarcocephalus*, *Anthocephalus*), the latter characteristic occurs in few *Rhizophoraceae* (e.g. *Carallia*, *Rhizophora*, *Bruguiera*, *Gynotroches*), but the structure of the flower of *Mastixiodendron* makes it impossible that this genus might belong to the latter family.

Index of collectors numbers of *Mastixia*.

indicating the species by means of their number (1 = *M. pentandra*, 2 = *M. parvifolia*, 3 = *M. kaniensis*, 4 = *M. rostrata*, 5 = *M. bracteata*, 6 = *M. cuspidata*, 7 = *M. Scortechinii*, 8 = *M. tetrandra*, 9 = *M. trichotoma*).

ACHMAD 109 : 9; 500 : 9; 510 : 9; 588 : 9; 696 : 9; 1183 : 9.

AMDJAH 55 : 6.

BECCARI P.B. 1559 : 5; P.S. 46 : 9; P.S. 956 : 4.

BLUME s. n.: 1, 4 & 9.

BOSCHPROEFSTATION.

BB-NUMBERS: 2254 : 9; 2255 : 9; 2286 : 9; 2446 : 9; 2932 : 9; 3988 : 4; 5229 : 8; 5499 : 9; 6234 : 9; 6666 : 9; 6710 : 9; 7415 : 9; 7826 : 9; 8922 : 4; 8925 : 4; 9171 : 9; 9888 : 9; 10028 : 1; 10237 : 9; 10297 : 9; 11064 : 5; 11177 : 1; 11180 : 1; 11287 : 9; 11578 : 9; 11581 : 1; 11638 : 5; 11963 : 5; 12609 : 4; 14153 : 9; 14155 : 9; 14267 : 9; E. 1053 : 1; TB. 208 : 9; TB. 1085 : 1; 158E.1P.850 : 1 & 8;

OTHER NUMBERS: 68T.1P.124 : 5; 98T.3P.261 : 9; Ja.1368 : 9; S.W.K.II.27 : 9.

BÜNNEMEYER 9572 : 9.

BURCK & DE MONCHY s. n.: 9.

BUREAU OF SCIENCE, MANILA 38841 : 3.

BURKILL & HOLTUM 7840 : 1.

CANTLEY'S COLLECTOR s. n.: 9.

CLEMENS s. n.: 2 & 9.

CURTIS 919 : 1; 1564 : 9; 3575 : 9.

DEL-PROEFSTATION 1380 : 4.

DEN BERGER 122 : 9.

DERRY 584 : 9; 1036 : 9.

ELMER 11644 : 9; 21584 : 4; 21870 : 4.

ENDERT 2572 : 9; 2577 : 4; 3310 : 1; 3465 : 9; 4317 : 4; 3429 : 9; 4769 : 9.

FORBES 2744 : 9.

GARAI (HAVILAND) 957 : 9.

GRASHOFF 895 : 1.

HALLIER B. 569 : 2; B. 1836 : 9.

HANIFF 3759 : 1.

HAVILAND 957 : 9; 3020 : 9.

HAVILAND & HOSE 3625E : 9.

HOLMBERG 840 : 5.

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ON THE SPECIES CONCEPTION IN RELATION TO TAXONOMY AND GENETICS

by

W. A. GODDIJN.

(*Leiden*)

A phylogenetic system resulting from comparative morphological studies claims to be the expression of evolution. The character of any phylogenetic classification based on morphological studies exclusively is a speculative one. The fragmental facts procured by fossil relicts from earlier geological periods are also morphological and allow only the conclusion that evolution took place, but in which way changes evolved has not been stated by immediate observation.

Nobody escapes from the idea that all living beings existing yet, have originated from those in the past. It is undeniable that the vegetation which covered the earth in former periods has been changed. This historical process seen as a continuity possible by the power of reproduction of the organisms is called evolution. The idea of evolution which as a consequence of Darwinian views penetrated into taxonomy is cause of the fact that species, families, ordines, phyla were considered to be more than categoric divisions; they should represent relationships or lines of descent. Taxonomy got a fundamental frame: phylogeny!

The idea that higher organised (more complicated) beings should have risen from the lower organised (simple, or seemingly simple) ones is so plausible to human mind that a theory sufficiently adapted to this idea would be accepted natural and evident. In phylogeny the principle of evolution from lower to higher organisation is brought to expression. Plants and animals surrounding us, as seen from a phylogenetic point of view, form the youngest shoots of a branching system but about the very branching our knowledge is the least. Not of a single genus, not even of a single species we know the direct descent from a genus or a species in a former period. On the other hand we believe in seeing main lines of development in phylogeny, but as soon as we try to reconstruct details we are driven from facts into hypothesis. Phylogeny therefore is and can not be more than a speculative science. Aiming to fix the results of evolution, relationship by means of descent can be

made plausible or perhaps even probable, but nothing of this kind can be proved.

In all theories of evolution a common tendency can be observed. They all intend to explain the origin of species. Lamarckism, Darwinism, Mutation- and Hybridizationtheories are as many trials to reveal the origin of the taxonomic units, the species. The two first mentioned theories are built upon philosophical bases, the latter two arose in a period in which genetics began to foot on solid ground.

It is evident that one's species conception must be influenced by one's point of view: the taxonomic and the genetic conception do not fully agree, the first being constructive, intending to delimit groups of organisms under considerable personal appreciation of morphological characters, the second being analytic, based on experimentally proved hereditary individual characters. The taxonomist takes a species as a morphological unit, the geneticist as a population of individuals of different constitution. With regard to the species conception the taxonomist and the geneticist are on similar terms as the author and the critic.

Till the time of LAMARCK the species conception was inviolable. It was the conviction that the species was a created unit (LINNAEUS) and that its constancy was beyond doubt. LAMARCK was the first who got insight in its variability and took from it the possibility of evolution. He meant that an individual could vary in a manner profitable for this individual. Essential to this theory is: reaction of the individual to the environment by direct adaptation; changes of the milieu could alter the type with hereditary effect. Darwinism propagated an allround variation. Only the best utilised individuals survived as a result of competition and nature itself selected the fittests. The most frequent form of a Linnean species was the type. As long as the type remained the fittest it kept the majority and constancy of the species to a certain extent was the result. Varieties were incipient species which by selection could raise to the rank of species. The title of the famous work "Origin of species by means of natural selection" shows that DARWIN understood evolution as the offspring of new species.

Characteristic to modern theories is that the points of comparison are changed under influence of genetics. Not the characters are inherited but the genes manifesting the characters during the individual development. The phenotypical appearance became of secondary importance. Though the moment of evolution still lies in the origin of species, the basis of all evolutionary consideration was the genotypical

constitution, the hereditary units, transmitted from parents to children, forming a set completely present in the nucleus (intracellular pan-genesis).

DE VRIES assumes the possibility of changes in the gene sets causing mutations. Not only latent genes may become active, or genes may get lost, but also genes may be formed de novo, in the latter case giving rise to progressive mutations. This kind of mutation implies evolution but various hypothetical considerations are necessary to emphasize the evolutionary moment (premutation periods) and as progressive mutations are very rare the direct significance for evolution diminishes considerably.

LOTSY's theory of evolution by means of hybridization tries to explain the origin of species by recombination of genes made possible by the power of sexual reproduction. To LOTSY's opinion the fusion of gametes of different constitution is the primary cause of all diversity among organisms. The surviving forms in a hybrid population are not the fittest ones selected by nature but those which are eventually best adapted to the existing circumstances. Isolation is the cause of differentiation of new species. Not selection of existing forms but succession determines the changes of flora and fauna in successive periods. No complicate hypothesis underlies this theory and the only assumption induced by the theory itself is polyphyletic origin of species.

One may doubt whether hybridizing was the only way evolution took, it is a matter of fact that crossing gives rise to considerable diversity. A single cross between two species e.g. *Tragopogon pratensis*. *T. porrifolius* shows more diversity in its progeny than any other phenomenon. The greatest advance in experimental evolution are the bi- and trigeneric hybrids (*Aegilotriticum*, TSCHERMACK; *Raphanobrassica*, KARPECHENKO).

The importance of hybridization as a cause of the origin of species cannot be better evidenced than by BAUR's latest publication (1932, p. 289). From experimental researches on species of *Antirrhinum* (sect. *Antirrhinastrum*) BAUR formerly explained the origin of new forms by mutation. On account of his investigations concerning forms occurring in Spain, however, he now declares (l.c.) that it is possible to explain the total abundance of diverse forms from the crossing of a few originally present forms. He declares that he is able to reproduce all types of *Antirrhinum* that now can be found in Spain, Italy and North Africa by means of material consisting of only one form from each of the groups *Antirrhinum latifolium*, *A. majus*, *A. Barrelieri*, *A. ramosissimum*, *A. glutinosum*, *A. molle* and *A. Siculum*!

The phenomenon discovered by MENDEL that the hereditary units do not lose their individuality and being transmitted to a following generation are separated individually, could be used to a certain extent for phenotypic analysis (dominance and recessiveness). Mendelism got a powerful support by MORGAN's interpretation of the mechanism of Mendelian heredity. The crossing-over theory created the possibility to study the localisation of genes in the chromosomes. Chromosome numbers and chromosome morphology induced taxonomy on a cytological basis.

Hundreds of evidences from experimental work showed that the species could not be regarded as a unit based on genetic identity. It is evident that the morphological species conception had to undergo the criticism from genetic standpoint. The attempts to change or to enlarge the species conception with genetic, cytological and ecological elements have lead to better insight in the problem and brought the investigators on different lines to a field of mutual research; yet the needs of phylogeny could not be satisfied by mendelian or cytological data.

The best starting point for comparison of taxonomic and genetic views is the Linnean species. Undoubtedly the delimitation of species and minor groups with the use of morphological criteria can be carried to extremes which easily leads to naming single specimens in the herbaria. Units minor to the species have little taxonomical value. There characters are more influenced by environment.

Varieties must possess hereditary characters which distinguish them from the species, modifications are due to environmental effects. Inspection alone is an untrustworthy criterion *).

As a rule, however, the herbarium specialist disposes of a few specimens only and the geneticist will object that in those cases only a few of the combinations of characters possible in the species are represented. Nevertheless it is quite possible that the species of the taxonomist coincide with the genetic delimitation, as all phenotypical manifestation is due to the genetic constitution. Genetical researches are useful to expose the artificial nature of morphological classification. It is perfectly true that modern taxonomists do not regard the Linnean species as a model of a taxonomic unit. Not all species described by LINNAEUS are moreover collective ones. The collective species of LINNAEUS

*) STIEFELHAGEN (1910) p. 468, calls *Scrophularia Neesii* WIRTG. a modification of *S. clata* GILB. Experimental investigation has proved that *S. Neesii* is a distinct form which even can be regarded as a good species (GOETHART and GODDIJN, unpublished).

are taxonomically as well as genetically groups of polymorphic organisms. The taxonomist however clings to his species conception. All minor differences revealed by genotypic analysis do not disturb his own categories. To him species are representations of ideal forms to which he ascribes specific morphological characters of real value. Be it that his species are abstractions, he will always regard them as natural groups of organisms. The individuals of a distinct group may not be alike and differ in many characters, they are all the same different from individuals of other groups. The different groups are separated definitely by morphological, ecological or even physiological divergences and a relative constancy of each group for longer periods is the justification of delimitation in categoric units such as species are. Delimitation of species taxonomically occurs independent of any theory of evolution!

The last consequence of Mendelian segregation with regard to the species conception was drawn by LOTSÝ (1916). To his opinion the smallest taxonomic unit which could bear the name of species should be a group of individuals of identical constitution unable to produce more than one kind of gametes, in other words: species should be pure homozygous constitutions. Though the idea is perfectly logical, changing the meaning of the taxonomical species violates the historical development of the conception too much and moreover does not fit practical purposes. Such groups of homozygous individuals may be apt for genetic research, in taxonomy they are rather useless. This fact has been often repeated, but LOTSÝ's idea must not be judged from this single suggestion. Later on he never again used the term species in this sense. Totally pure homozygous constitutions, if they occur in nature, can never be proved. Even in pure lines no certainty can be obtained that the constitution as a whole is homozygous. The intention of LOTSÝ's terminology was to replace the term species in taxonomical sense by another one expressing its evolutionary value. The Linnean species he named *Linneon*, consisting of minor definite groups called *Jordanons* (microspecies) and the term "species" than should be preserved for the smallest genetically possible units. "Species" in the publications of LOTSÝ must be understood as *Linneons*.

For cases of intercrossing *Linneons* with fertile crossing products, mixing up with the parent *Linneons* to a bigger crossing association, he proposed the term *syngameon*. The *syngameon* embraces those polymorphic groups in which two or more *Linneons* (species) intermingle

and the Linneons are linked by transitional fertile hybrid individuals. This series of terms thus is testifying the evolutionary thought of the hybridization theory. They represent the species conception of a geneticist who spent a great deal of his life on taxonomy. Lotsy's terminology was meant to preserve systematic categories and in the possibilities of crossing he tried to find limits for natural groups. His definition of a "species" was rejected, but the terms Linneon and syngameon have found approbation of many authors. All the same the taxonomist will not be satisfied by this categories as the syngameons represent the most difficult things to deal with in taxonomy. When the taxonomist is able to find out the parent species in a hybrid population he does not care much for the syngameon. The greatest difficulties arise in highly polymorphic groups designated as syngameons in which the constituent species, possibly more than two, can not be easily recognized. A great trouble are those in which the transitional forms could have risen from crossings other than the likely supposed parent species; the extreme diverse forms of a syngameon need not be identical with the species which caused the origin of the syngameon. It is quite possible that within a syngameon the parent species are lost and new species are not differentiated. Determining syngameons remains a trouble as they always will require experimental investigation to prove the hybrid constitution of the constituents. In complex syngameons the possibility that other than the supposed parents have shared in the constitution of certain forms, is not excluded. Such populations will be regarded as species, or divided into subspecies, or simply taken as hybrid populations. Several hybrid populations are described by LOTSY, COCKAYNE, ALLAN, HERIBERT NILSSON, and I have only to mention the syngameons *Nothofagus Cliffortioides* \times *N. fusca* (Lotsy 1925) of the New Zealand forests and *Euphorbia Bothae* P. h. and *Euphorbia anticaffra* P. h. of the Fishriver district in the Cape Province of South Africa, to point out their significance for the vegetation and the rôle they play in evolution (Lotsy and GODDIJN 1928). The *Nothofagus* forests consist for a considerable part of hybrid populations. *Euphorbia Bothae* and *Euphorbia anticaffra* are covering vast regions of the Fishriver valley and in localities of square miles even dominate the aspect of the vegetation. These two hybrid populations are linked and though they are recognized as syngameons by inspection, nothing more can be said with certainty about their presumable origin than that *Euphorbia coerulescens*, *E. tetragona* and *E. triangularis* have something to do with them. Only experiment

can bring further insight. The diversity in *Euphorbia Bothae* is so considerable that f.i. at Botha Hill no two specimens growing close together are alike. So it takes no wonder that several forms were described as distinct species (*E. Ledienii*, *E. Franckiana* a. o.); such species could be augmented ad libitum (LOTSY and GODDIJN 1928).

Less complicated syngameons as the hybrid populations of *Cotyledon* species are more or less localized, but nevertheless they are linked by the possession of a mutual parent. They also occur in the Eastern Cape Province e.g. *Cotyledon coruscans* \times *C. teretifolia*, is connected on one side with *C. teretifolia* \times *C. Beckeri* and *C. teretifolia* \times *C. gracilis*, on the other side with *C. coruscans* \times *C. Beckeri* and presumable also with *C. coruscans* \times *C. gracilis*. Also other hybrids of *Cotyledon* were recognized such as *C. paniculata* \times *C. Wallichii* which seemed to be an isolated hybrid population. The *Cotyledons* of South Africa thus demonstrate a genus in a period of evolution, separated syngameons being on their way of developing new species.

Another example of a remarkable hybrid population may be mentioned here. At Menaggio on the Lago di Como (and also at the Lago Maggiore) hybrid populations of *Primula acaulis* \times *Primula officinalis* occur, showing a great diversity. Out of this population a new Linneon embracing a group of intermediate forms will probably develop. At the outskirts of the syngameon stand forms, nearing the parent species, which certainly will be regarded as members of the parent linneons. Among the segregation products occur a very few forms resembling closely *Primula elatior*, and it is not improbable that *P. elatior* should have risen from a crossing between *P. acaulis* \times *P. officinalis*.

In different localities in Switzerland the hybrids *P. acaulis* \times *P. elatior* (e.g. at Flüelen) and *P. elatior* \times *P. officinalis* (on the Rigi at Felsenthor) occur. Where the possibility of crossing between the three species is present, a complex syngameon is formed. In such a syngameon the combination of parent characters in the separate individuals can hardly be recognized by inspection. Exploration may give the conviction that different Linneons are fused, but experimental statement must confirm the field work.

The only way to solve taxonomical difficulties with polymorphic species goes along lines of experimental research. *Scrophularia Neesii* WIRTG. and *S. Ehrharti* STEV. are closely allied species; they intercross and produce partly fertile, partly sterile progeniture. The products of crossing and backcrossing (only partly with one of the parents) are

rather undistinguishable from the parent species. The parent species themselves in their extreme forms are distinct enough, but as no definite criterion separates them they have often been confounded. All their characters being transgredient, it is plausible that some taxonomists took them together into one and the same Linneon (*S. aquatica* L.; *S. alata* GILLB., in which probably even more species are included). Nevertheless *S. Ehrharti* and *S. Neesii* are separated physiologically, behaving themselves as distinct species when crossed with each other and their reaction being different when hybridized with a same foreign species *).

DANSER (1929) also tried to delimit the possibilities of crossing but he did not touch the taxonomic categories, intending to point out the phylogenetic origin of populations (convivium). All individuals which are hold together by possibilities of hybridization are called a *comparium*; it does not matter whether the products of hybridization are fertile or sterile. Such groups will as a rule not coincide with taxonomic categories, but are certainly of value for phylogenetic purposes. An association of individuals which are connected by possibilities of exchanging genes, i.e. which can be intermingled, DANSER calls *commiscuum* (Vermischungsgenossenschaft). These groups may coincide with, or approach to a species; they are polymorphous like Linneons. *Convivia*, however, are populations, groups of individuals, differentiated within the commiscuum, isolated by geographical influences. Here also isolation is introduced to explain the cause of differentiation. The concepts of LOTSY and DANSER are biological ones. DANSER attempts to find delimitations in connection to plantgeography.

A convivium must be more or less distinguished from the other parts of the convivium, forming a group of close resemblance and hold together by circumstances limiting their intercrossing. A convivium may coincide with a species in certain cases, but not necessarily does. Under particular conditions subspecies or varieties may form convivia. At the best a convivium can be compared with HAAGEDOORN's species as DANSER himself discusses, a population tending to reduce its potential polymorphy. (The potential variability is given by the number of genes in respect to which a group of individuals is not homogenous. The qualitative stability of genes accepted, the potential variability in a population of limited crossing possibilities reduces automatically, according

*) An account on experimental work with *Scrophularia* by Dr GOETHART and the present writer is in preparation.

to HAAGEDOORN (1921). DU RIETZ (1930) accepts this even as a law). DANSER (1929) has given different examples to illustrate his concept.

It is evident that DANSER, in more refined a way than LOTSY, thought in the same line, trying to delimit groups the origin of which could be understood. The mere morphological species conception is insufficient for such a purpose. No grouping on particular line will clear up phylogenetic relationship between species and certainly not a morphological system of classification.

We have no certainty that the natural taxonomical groups are branches of a natural system. They are groups based on external resemblances, separated by gaps of discontinuity. To ascribe resemblance between groups to phylogenetic origin is a mere hypothesis (conf. LOTSY 1925).

Another refined attempt of grouping individuals was made by TURESSON (1929). He saw the species delimitation as an ecological problem. Ecological experiments have shown that species of a wide distribution, being divided over different localities (habitats) split off races of different hereditary characters. When different ecological types, definite morphologically distinguished races, are tied to different habitats by edaphic factors, belong to the same Linneon, those races are not to be regarded as a kind of species. In essential points there is no fundamental difference between TURESSON's and DANSER's concept, although the term *convivium* has a wider sense than *ecotype*. One could say the *ecotype* is a *convivium* caused by ecological influence. Four groups are discerned by TURESSON: *coenospecies*, a population in which species group themselves on account of vitality and sterility limits, but all of common origin so far as indicated by morphological, cytological or experimental facts; *agamospecies*, apomictic population under the same conditions; *ecospecies*, an amphimict population with vital and fertile descendants but more or less sterile when crossed with constituents of any other population; the *ecotype* is the response (genotypical) of an *ecospecies* to a certain habitat. GREGOR (1931) e.g. in his study on experimental delimitation of species gives a case in which the system of TURESSON has been applied. *Phleum pratense-alpinum* form a *coenospecies*. In *P. pratense* two groups are cytologically discerned which do not intercross, a hexaploid and a diploid one. In *P. alpinum* likewise two groups exist, a tetraploid and a diploid. These groups are considered as *ecospecies*. Some *ecotypes* of *P. pratense* could be distinguished, four of diploid and three of hexaploid constitution.

In an extensive study on the fundamental units of biological taxonomy DU RIETZ (1930) redefined the terms form, species, subspecies and variety, grouping them morphologically, laying much stress on the effect of geographic isolation and the automatic reduction of polymorphy. DU RIETZ accepts JOHANNSEN's definition of a biotype, a population consisting of individuals with identical constitution (*Elemente der exakten Erblichkeitslehre*). The variety is a population consisting of individuals of one or more biotypes forming a more or less distinct local facies of a species. The subspecies is a population of several biotypes forming a more or less distinct regional facies of a species, and the species he calls the smallest possible natural populations permanently separated from each other by distinct discontinuity in a series of biotypes. The importance of hybridization and isolation comes to light when he defines the species as: a population consisting either of one strictly asexual and vital biotype, or of a group of practically undistinguishable, strictly asexual and vital biotypes, or of many sexually propagating biotypes forming a syngameon separated from all others by more or less complete sexual isolation or by comparatively small transitional populations.

This concept agrees with the views of LOTSY, DANSER, HAGEDOORN, HERIBERT NILSSON and many others. Criticism of DU RIETZ's views says that he apparently disregards the selective effect of environmental conditions on a genotype complex (conf. GREGOR a.o.) Anyhow DU RIETZ does not deny the possibility that mutation may play a rôle in the process, but he is convinced that the role of isolation in nature is sufficient to explain the process of differentiation. Differentiation by means of automatic reduction of polymorphy is enough to explain what we see in nature. The rôle of selection seems to him overestimated and herewith many other authors agree (conf. DU RIETZ 1930, p. 399).

One other species concept may be mentioned here, more particularly in connection with cytogenetics.

Some points may be stated as evidence from cytological work firstly concerning the basis of heredity. From cytogenetic standpoint it is not a mere assumption that the species have practically a constant number of chromosomes (genoom). A second fact of importance is the probably linear arrangement of the genes, the primary hereditary units, in the chromosomes. The chromosomes occur in pairs, in which the genes occupy identical loci. The chromosome sets consisting of n pairs, the hapliod generations have n chromosomes, and this number, though not always, being constant, proved to be in many cases a characteristic feature of related species.

Multiple series of chromosome numbers with a basic number apparently have taxonomic value. The work of CLAUSEN on *Viola* and of HURST, TACKHOLM, BLACKBURN and HARRISON on *Rosa* have become classic in this respect. CLAUSEN found that a definite series of chromosome numbers occurring in *Viola* species coincides with taxonomical groups; he divided the section *Melanium* in subgroups based on the numbers of chromosomes. Not always it will be possible to classify a genus according to this principle. Such divisions can be made when a basic number in the somatic cells is stated and degrees of polyploidy may be used to separate the different sections. The study of chromosome morphology, however, widened the prospects for systematic applications and even proved to be of more value than the numbers solely. This has been the merit of NAVASHIN and his school (LEWITSKY, DELAUNAY, TAYLOR, HOLLINGHEAD, MANN, LESLY, AVERY, ROSENBERG etc.). According to these investigators the chromosomes could be used not only for classification, but also for revealing phylogeny of species, by studying chromosome morphology (size, form, satellites, constrictions a.s.o.). This kind of study combined with phenotypical appearance of the species considerably raised the value of cytological investigation and has produced even systems of classification. A single case may be mentioned to illustrate the bearing (stretching) of such investigations. HOLLINGHEAD and BABCOCK (1930) published an interesting study on chromosomes and phylogeny in the genus *Crepis*. No less than 70 species were cytologically studied by different investigators. Now in *Crepis* apparently the similarity of chromosomes points to a common origin. The American species can be arranged in a polyploid series, some of the European species too, the others probably arose from interspecific hybridization. These species were divided into sections, one of which, *Paleya* with the basic number 10, could be considered as the most primitive subgenus from which the other subgenera could be derived: *Barkhausia* with the numbers 8, 10 and 16, *Catonia* with 12, and the heterogeneous *Eucrepis*. *Paleya* could be supposed to contain or to have contained the progenitors of all other subgenera. In *Eucrepis* the connecting forms have disappeared with *Paleya*. Now it is evident from the discussion that different assumptions as to the chromosome changes are made, but there remains the fact that morphological similar species have similar chromosomes and that the phylogenetic system projected by the authors for the genus *Crepis* undoubtedly proves the great value of this studies for taxonomy, showing the connection between chromosome number

and chromosome morphology on one side with phylogenetic relationship on the other.

Acknowledging that Mendelian heredity, except in the cases of cytoplasmatic inheritance, during more than 30 years established by numerous experiments as the basis of all heredity, consolidated by MORGAN's school with cytological data, it is plausible that cytology must be drawn into consideration at the delimitation of species. A step to a cytogenetic species definition was made by BABCOCK (1930).

BABCOCK states from existing evidence that the hypothesis of DARWIN and LOTSY are at least in part correct and that the present species must have risen through differentiation aided by isolation within pre-existing species. Interspecific hybridization is rather common in various genera (*Hieracium*, *Rosa*) and numerous hybrids exist in nature by apomixis.

Tetraploids are often self-fertile, triploids have low fertility but, as NAVASHIN proved for *Crepis capillaris*, may sometimes serve as starting points for a series of polyploids. From experimental interspecific crossing it is known that all degrees from fertile to sterile can occur, but that there is a general tendency towards sterility.

BABCOCK accepts hybridization as a modus of origin of species in nature; however, the primary processes in species origin are to him the gene mutations and the chromosome transformations. According to MORGAN and MULLER gene mutations can be experimentally obtained and can arise de novo.

BABCOCK thinks that gene mutation creates the possibility of interspecific differentiation (polymorphic species), but he admits that chemical changes of genes, loss or addition is insufficient to account for differences in chromosome morphology and chromosome number among species of many genera.

Three modes of cytogenetic variation are important: 1. gene variations (mutations), 2. chromosomal variation (addition, rearrangement, translocation, transformation, delation), 3. polyploidy.

As to the species conception BABCOCK constructs seven basic ideas, as follows:

1. Common structural characteristics which unite certain individual organisms into one group, the species. Cytogenetically: the common genetic basis is represented by a specific chromosome complex.

2. Certain characteristic features which distinguish such groups

from each another. Cytogenetically: mostly represented by the chromosome garniture (genom).

3. Relative stability combined with more or less variability. Cytogenetically: made possible by chromosome distribution from cell to cell, inherited variations arising from occasional changes in genes and chromosomes.

4. Common descent of all individuals of the group from one or more preexisting species. Cytogenetically: explained by the mechanism of heredity and genetic variation.

5. Free intercrossing and high (but not necessarily complete) interfertility among the individuals of the group. Cytogenetically: in accordance with the homology of genes in the chromosomes of the individuals.

6. Absence of free intercrossing and usually low fertility if not complete sterility in hybrids between different species (although highly fertile and constant new forms may sometimes arise in this way). Cytogenetically (with a few exceptions): the logical result of accumulation of genic and chromosomal differences between diverging groups of individuals within the species.

7. The facial occurrence of subspecific groups, often occupying different geographic areas which differ more from one another in structure or interfertility or both than do the individuals composing each subgroup. Cytogenetically: this must be regarded as the result of genetic variability within the species, the influence of changes in the environment isolation and of natural selection.

I have quoted BABCOCK (though other geneticists contributed to species conception, such as HALDANE, FISHER a.o.) because in his concept can be seen a trial to conciliate the taxonomic and the genetic ideas, and the points resumed may lead to a cytogenic species definition. Certainly both lines must be followed; morphological and genetic taxonomy are meeting, the mutual interest ends in phylogeny.

The solution of evolution problems is always sought in the origin of species. Suppose we know the origin of species: let it be hybridization or mutation, or both. From species arise again species; neither mutation nor hybridization has shown something else. Hybridization goes the farthest in experimental evolution by bi- and trigeneric hybrids, from which possibly a new genus might arise. Nothing of higher taxonomic rank is formed. It is evident that only a part of a given genetic constitution can be analysed. Evolution is not solved with the origin of species; the evolution problem is a phylogenetic one.

As to the bearing of the species conception to phylogeny nothing can be said that is not hypothetic. PLATE (1932) is right when he says that genetics is unable to all apply for phylogenetic needs. The geneticist is interested in the study of the present world, he is working with species of the present time, the last result of evolution; the phylogenist goes back to endless times embracing wider groups than species are. Phylogeny becomes impossible without accepting Lamarekian views of adaptation to some extent. Genes are not characters and only possible in a gene complex interacting in a genetic constitution. Characters and organs cannot be handled a like genes. How should we know that genes manifesting characters, organs, individuals were in constant static condition for geological periods? Perhaps time will come that we are able to understand better static and dynamic processes in evolution and may look upon the problem of acquired characters as a genetically plausible phenomenon.

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NOTES ON THE GENUS DIGITARIA,

with descriptions of new species

by

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(Leiden)

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Some years ago I had the opportunity to study more extensively a very interesting group of grasses, belonging to what is now accepted as a distinct genus, the genus *Digitaria*, formerly belonging as a sub-genus to the genus *Panicum*. As to living plants of this group I was familiar with two european species, also found in the Netherlands. They are treated in the Synopsis of ASCHERSON and GRÄBNER and once more in the second edition of this work. Under *Panicum* they bear the names *P. lineare* KROCKER and *P. sanguinale* L. The first species belongs to HACKEL's „*Ternata*“, the name is invalid on account of the *Panicum lineare* of LINNAEUS, a species described from India, we know that KROCKER's plant does not occur in India and it is therefore necessary to look for the correct name of the species. A more detailed study of the synonyms and their priority proves that the valid name is that of SCHREBER, published by SCHWEIGGER as *Panicum Ischaemum*. ASCHERSON gave as the date of publication for this name, the year 1811, if this was indeed correct, our species had to bear the name of *Digitaria humifusa* PERSEON, published in the year 1805, the citation of the year 1811 by ASCHERSON is however wrong as SCHREBER's name was published in the year 1804. This is evident from SCHRADER's work, where is published the same species as *Syntherisma glabrum*, this was done in the year 1806 and as a synonym is given the *Panicum Ischaemum* SCHREBER, given in SCHWEIGGER's Flora. It was MUHLENBERG, who, in the year 1817 took up SCHREBER's name under *Digitaria*, he published the species as *Digitaria Ischaemum* with SCHREBER as author. The name of our species, which also occurs in America, is thus ***Digitaria Ischaemum*** (SCHREB.) SCHREB. ap. MUHLENBERG. It is curious that such a common species escaped to the attention of LINNAEUS. The species is easy to recognize and not

very variable. Among the few varieties the most characteristic one is the var. *prostrata* (ASCH. et GR.) HENR. nov. comb., with long runners rooting at the nodes; the variety *hirta* (JUNGE) HENR. is not so important, the lower sheaths are not always quite glabrous and a more or less distinct pubescence is not rarely observed.

Our second species described as *Panicum sanguinale* becomes under *Digitaria*, the **D. sanguinalis** (L.) SCOPOLI. Botanists who have studied the type in the herbarium of LINNAEUS, indicate that this type represents the european plant treated under this name in our manuals. If we study only the literature of this species, we find that it is common all over the world, there is scarcely any flora where the species is not mentioned, with exception of the cold regions. All the tropical floras give the species as an indian plant and we find it thus in HOOKER's Flora of British India and in the works of the recent Dutch botanists. Many years ago when I saw for the first time the so-called *Panicum sanguinale*, I found already that the javanese plants did not agree with our european *P. sanguinale* and being familiar with the latter in the living state, I was not willing to accept the indian specimens as belonging to our *D. sanguinalis*. Since that time I could study a very extensive material of *D. sanguinalis* from localities all over the world and my opinion on the tropical plants was not changed. That we have two distinct species before us was already pointed out by the american botanist NASH, who accepted the plant from the southern regions of N. America as a distinct species under the name of *Syntherisma marginata* NASH, based upon LINK's *Digitaria marginata* from the year 1821. Having studied LINK's type in the Berlin Herbarium, I recognized it as being indeed the indian *D. sanguinalis*. LINK gave the locality as Brazil. It is further noteworthy that the very accurate Dutch botanist BUSE did not mention the *Digitaria sanguinalis* in his enumeration of JUNGHUHN's indian grasses. Since NASH accepted the two species as different, modern american agrostologists neglected them in their works and accepted only a *Digitaria sanguinalis*. In the beautiful book of W. A. SILVEUS on the Texas grasses, only the *Digitaria sanguinalis* is taken up, although the typical *D. marginata* occurs there. The plate on p. 489 in SILVEUS's book and also his drawings represent the *D. marginata*, it may be that the true *D. sanguinalis*, although represented in N. America too, is not found in Texas.

European agrostologists, familiar with tropical grasses, had however a better idea and two eminent agrostologists, Prof. PILGER at Berlin and

Dr STAFF at Kew gave more attention to these plants, they both had the same opinion, that the *D. sanguinalis* of Europe was not found in the tropical regions of the world. My opinion that we have thus two different species, is now supported by two such competent agrostologists and in the monograph of the genus *Digitaria*, prepared by me, I have pointed out the geographical distribution of the two species and their taxonomical characters. The form and outline of the spikelets give us good characters to recognize the two species. As is already said the *Digitaria marginata* is the tropical species and being widely distributed and common, it certainly did not escape to the attention of the earlier botanists and it was therefore very probable that there was already a name for the species; described by LINK from South America, the species was found by HUMBOLDT and described in the Nova Genera by HUMBOLDT, BONPLAND and KUNTZ as *Panicum adscendens* in the year 1815. I therefore give here the new combination of the species as ***Digitaria adscendens*** (H. B. K.) HENR.; it was HUBBARD who accepted a still earlier name for the species, the name *Digitaria velutina* P. B. from the year 1812, based upon the *Phalaris velutina* of FORSKAL (1775), a *Digitaria* too. This arabian plant belongs as to the plants seen from the arabian localities, to my opinion to an allied, different species.

There occurs in Europe another interesting *Digitaria*, treated as a variety of *D. sanguinalis* in our manuals under the name of var. *ciliaris*. This name goes back to RETZIUS, who described a *Panicum ciliare* from Java and China. Because the true *D. sanguinalis* is not an inhabitant of the tropics, the plant named *P. ciliare* by RETZIUS cannot belong to the european plant as a variety. It was TRINUS, who placed the *Panicum ciliare* of RETZIUS as a variety under *Panicum sanguinale*, he followed KOELER, who took up the combination *Digitaria ciliaris* (RETZ.) KOELER, but identified RETZIUS's species with the european form, which is treated here shortly by me. In many species of *Digitaria* of the group of the „*Binata*”, where the spikelets are paired along the rachis, there occur two characteristic variations, these forms we can accept as two subspecies of the same species, they agree in all the characters but differ essentially in the pubescence of the flowers. The common form of *D. sanguinalis* has outer scales (gl. II and III) more or less villous between the nerves and along the margins, the hairs are always soft, adpressed or ultimately spreading. This plant was described by SCHRADER as *Syntherisma vulgare* in the year 1806 and is taken up by me as subsp. ***vulgaris*** (SCHRAD.) HENR. under *D. sanguinalis*. There occurs another form where the

margins of glume III are provided with curious thick, hyaline, stiff bristles, arising from crateriform tubercles. This is the plant accepted by KOELER as the *Panicum ciliare* of RETZIUS. A study of the indian and malayan material proved that the so-called european var. *ciliaris* does not occur in those regions, although *Digitarias* with such bristles are found in India, they do not belong however to the *D. sanguinalis*, but represent partly the subspecies of the tropical *D. marginata*, partly they belong to other allied species.

From all the data we know at the moment, it is thus evident that the bristle-bearing subspecies of *D. sanguinalis* cannot longer bear the specific name of RETZIUS, as the name, whatever it may represent (there is no specimen in the herbarium of RETZIUS) applies to an indian grass.

Since KOELER and TRINIUS no other name was proposed for the european grass. In my work on *Digitaria*, having sharply separated the indian and the european *D. sanguinalis*, I had to give another name to the subspecies of *D. sanguinalis* with the bristle-bearing spikelets. I propose therefore to call this plant ***Digitaria sanguinalis* (L.) Scop.** subsp. ***pectiniformis* HENR. nom. nov.**, based upon the plant described by KOELER and figured by TRINIUS.

The variation between the two subspecies as given here by me is in most cases the only one and we are not justified to accept them as two different species, the other characters of the spikelets in combination with important differences in the vegetative parts are of major importance to limit the species of the genus *Digitaria*. VAVILOV's idea of the parallel variation is especially in the genus *Digitaria* of great importance and a happy solution of the problem. It is not a very bold hypothesis that at least in the group of the „*Binata*” of the genus *Digitaria*, there occurs in each species such a corresponding subspecies with the characteristic tubercle-based bristles, I have already found different of these forms in many species.

Digitaria Endlichii MEZ, represents the bristle-bearing form of the species, the parallel variation is ***Digitaria Endlichii* MEZ, subsp. *Meziana* HENR. nov. subsp.** Differt a typo speciei spiculis paullo angustioribus, sed praesertim valvula sterili (gluma III) nervis 7 scabris aequidistantibus percursa, marginibus haud longe fimbriatis, absque setis rigidis subcoloratis; gluma secunda marginibus tantum breviter pubescentibus. Tropical East Africa: Kilimandscharo, ENDLICH no. 751, (type in herb. Leiden); HITCHCOCK no. 25101 from Kenya belongs to the same subspecies.

***Digitaria natalensis* STENT, subsp. *Stentiana* HENR. nov. subsp.**

Differt a typo speciei praesertim gluma tertia absque setulis marginalibus hyalinis rigidis. Type in H. L. B. received from the Salisbury Herb. Southern Rhodesia no. 5706.

Digitaria Nealleyi HENR. nov. spec. Culmi — in specimine meo basi incompleti — decumbentes, superne geniculato-adscendentes, probabiliter haud repentes, multinodes, fere ex omnibus nodis ramosi, glaberrimi, canaliculato-striati, rubescentes; vaginae basales emortuae et tunc culmi nudi, superiores a culmo solutae, internodiis breviores vel subaequilongae, multinervosae, pilis patentibus e tuberculis ortis praeditae; vaginae ramorum internodiis longiores, subhiantes vel aretae, densius pilosae, nodi adpresse pubescentes, ligula vix 1 mm. longa, glabra, hyalina, albo-purpurascens, superne crenulata; laminae erecto-patentes vel patentes, 2—2½ cm. longae, planae, circa 1—2 mm. latae, lineari-lanceolatae, sensim acutatae, griseae vel supra violascentes, multinervosae, granulato-scaberrimae, marginibus undulatis scabris subinerassatis, nervo mediano subtus parum prominulo, utrinque praesertim inferne pilis longis basi tuberculatis fimbriatae, pedunculus, in speciminibus examinatis, haud longe exsertus; panicula erecta, axis abbreviatus, racemis paucis, rhachi triangulari-applanata, marginibus scabris; spiculae binae, altera pedicello ipsa ½ brevior, altera ipsa plus triplo brevior fulta, pedicellis triquetris scabris, spiculae lineari-lanceolatae, superne leviter angustatae, 3—3¼ mm. longae, 0.6—0.7 mm. latae, gluma inferior distincta, enervis, triangulari-acuta, haud raro apice rotundata, gluma superior spicula ⅓ brevior, lanceolata, acuta, 3-nervis, inter nervos et versus margines pilosa vel villosa, gluma III (sterilis) spiculam aequans, lineari-lanceolata, 7- vel sub-7-nervis, nervis aequidistantibus, dorso subglabra, marginibus villosis, gluma IV (fertilis) vix 3 mm. longa, sensim acutata, viridis, leviter punctulato-striolata.

TEXAS, collected by G. C. NEALLEY in the year 1884. Herb. HACKEL Vienna.

Digitaria dolichophylla HENR. nov. spec. Annua, dense caespitosa; culmi erecti, tenues, gracillimi, glaberrimi, simplices, longissimi, teretes, vix striati, cum inflorescentia plus quam 60 cm. alti, circa 4—5-nodes, nodis glabris, nodo summo vix 20 cm. supra basin culmi sito; foliorum vaginae infimae abbreviatae, valde nervosae, adpresse hirsutae, inferiores glabrescentes, tantum inferne supra nodos subpilosae, ore marginibusque sparse pilosis, internodiis sublongiores, vaginae superiores omnino glaberrimae, internodiis breviores, auriculae productae, ligula glabra, hyalino-fusca, subtruncata, circa 1½ mm. longa, cum auriculis connata; vaginae

ultimae longissimae, folia in basi culmi aggregata, laminis longissimis, involutis, vi explanatis circa 1 mm. latis, supra leviter pubescentibus, ad basin pilis nonnullis praeditis, setaecco-acuminatis, 25 cm. vel plus longis, circinnatim curvatis vel flexuosis, laminae foliorum culmeorum breviores; pedunculus longissimus longe exsertus, tenuissimus; racemus solitarius (raro racemi bini subconjugati), tenuissimus, vulgo ad 10 cm., haud raro ad 15 cm. vel plus longus, axis si adest circa 1 cm. longus, subangulatus, scabriusculus, rhachis filiformis, trigona, vix marginata, scabra; spiculae ternatae, adpressae, haud dense imbricatae, vel inferne remotae, pedicellis aculeolato-scabris, subtriquetris inaequalibus, primario spiculam superante, secundo ea paullo brevior, tertio pluries brevior fultae, anguste lanceolatae, 1.5—1.6 mm. longae, 0.6 mm. latae, inferne et superne angustatae, viridulae, gluma inferior deest, gluma superior spicula circa $\frac{1}{4}$ brevior, ea distincte angustior, praesertim superne, subaeuta, 3-nervis, inter nervos et praesertim versus margines pilis longiusculis apice capitellatis praedita, gluma III sterilis plana, circa 5-nervis, nervis aequidistantibus, lanceolata, apice rotundata, spicula paullo sed distincte brevior, inter nervos laterales et versus margines eodem modo ac II pilosa sed juxta nervum medium glabra, gluma IV fertilis spiculam aequans, lineari-lanceolata, distincte apiculata, apiculo exserto, punctulato-striolata, atro-violacea.

FLORIDA: Dade County; Buena Vista, 5 Dec. 1903 leg. A. A. EATON no. 459. Distributed from Ames Laboratory, North Easton Mass. Typus in H. L. B.

Digitaria rhachitricha HENR. nov. spec. Probabiliter annua (in specimine meo radices desunt). Culmi erecti, glabri, elongati e nodis superioribus parum ramosi, ramos breves floriferos solitarios gignentis; vaginae arctae vel superne hiantes, teretes, nervosae, marginibus hyalinis, dense patule hirsutae, pilis longis, albis, basi tuberculatis praeditae, nodis glabris parum prominulis; ligula brevissima, subtruncata, pilosula; laminae e basi subaequilata lineares, planae, sensim angustatae, acutae sed haud acuminatae vel setaceae, ad 3 mm. latae, 10—12 cm. longae, vel interdum longiores, nervo mediano albo subtus prominulo percursae, undique dense patule pilis basi tuberculatis hirsutae; pedunculus exsertus, elegans, teres, striatus, glaber; panicula subracemosa vel subdigitata, axis communis circa 3 cm. longus, triangularis, scaber, longe villosus, racemi circa 5, elegantes, subsolitarii, sessiles, erecti vel erecto-patuli, 10—12 cm. longi, ad insertionem longe villosi, inferne prope basin quasi subramosi, rhachi subtrigona, angustissime viridi-marginata, marginibus scabris hir-

sutis, pedicellis trigonis, scabris, pilis brevissimis hirsutis; spiculae ternae, sed ad basin racemorum inferiorum quaternae-senae (vel rariter septenae) ibique racemulos ad 1 cm. longos formantes, 1.5—1.6 mm. longae, ovato-oblongae, superne subacuminatae, pedicellis inaequilongis, primario spiculam superante, secundario ea paullo, tertiano pluries brevior fultae: gluma inferior minuta, annulato-evoluta, gluma superior anguste lanceolata, acuta, spiculam paullo brevior et distincte angustior, 3-nervis, inter nervos et versus margines pilis longiuseulis subrigidis leviter capitellatis munita, gluma III sterilis 5-nervis, spiculam aequans, juxta nervum medium glabra, inter nervos laterales et versus margines puberula, gluma IV fertilis apiculata, apiculo pallido haud exserto, atro-violacea, striolato-punctata.

AMERICA AUSTRALIS: Columbia, leg. FUNCK et SCHLIM no. 724. Type in H. L. B.; Santa Marta, leg. H. H. SMITH no. 187, cotype in H. L. B.

Digitaria divaricata HENR. nov. spec. Annua, culmi basi decumbentes ad nodos radicanes, superne adscendentes, plurinodes, e nodis inferioribus ramosi, glaberrimi, angulati, canaliculati, superne subcompressi, cum panicula 50 cm. vel plus longi, ad nodos pilosulae vel glabrescentes; vaginae internodiis breviores, vel eae ramorum longiores, inferne sparse patenter pilosae, pilis basi tubereulatis, superne haud raro glabrescentes, multistriatae, marginibus albis hyalinis, aetae vel eae ramorum superne hiantes vel a culmo solutae, ligula alba, scariosa, vix 2 mm. longa, glabra; laminae e basi subrotundata lanceolatae vel lanceolato-lineares, ad 1 cm. latae, circa 7—8 cm. longae vel eae ramorum circa 4 mm. latae, tenuinerves, multinervosae, nervo medio albo praesertim subtus conspicuo praeditae, utrinque plus minus pilis adpersae, marginibus undulatis scabris, sensim aeutatae haud setaceae; pedunculus inflorescentiae erectus, exsertus, valde striatus, subteres, glaber; panicula patula, circa 8 cm. longa, axis communis circa 5 cm. longus, anguloso-striatus, glaber, racemi remoti, ad 15, inferne bini vel terni, superne solitarii, divaricati, angulo recto patentissimi, ad 7 cm. longi, graciles, simplices vel inferne haud raro racemos secundarios edentes, racemi superne sensim decrescentes, subregulariter dispositi, in axillis pilis longis praediti, rhachi racemorum alba, plana, angustissime sed bene viridi-marginata, spiculis angustiore; pedicelli subtriquetri, scabri, superne haud vel leviter tantum patellati; spiculae adpressae, superne binatae, inferne haud raro ternae vel quaternae, subsessiles vel primariae bene pedicellatae, pedicello ad 1—1.5 mm. longo praeditae, lanceolatae, virides, angustae, 1.8 mm. longae, circa 0.6 mm. latae, inferne et superne regulariter angustatae haud acuminatae,

gluma inferior deest vel rudimento minutissimo indicata, gluma superior spicula paululo brevior, 5-nervis, inter nervos adpresse pilosula, gluma III regulariter 7-nervis, nervis aequidistantibus, glabra sed marginibus ut in gluma II pilosula, gluma IV vix $\frac{1}{2}$ mm. lata, spicula paullo brevior, subfusiformis, vel lineari-lanceolata, bene apiculata, minutissime punctulato-scaberula.

AFRICA ORIENTALIS: Nyasaland: Kyimbila, 1350 m.s.m. legit A. STOLZ in 1911 no. 635. Type in H. L. B.

Digitaria Eggersii (HACK.) HENR. nov. comb. *Panicum Eggersii* HACKEL, formerly accepted as a member of the genus *Trichachne* is now placed by me under *Digitaria*. There are so many intermediate species between the genera *Digitaria* and *Trichachne* that we cannot maintain the latter.

Digitaria collina SALISBURY is proved to be only a nomen nudum given for *Andropogon Ischaemum* L. The specific name *Panicum collinum*, given by BALANSA to a species from New Caledonia is therefore valid under *Digitaria*, and becomes **Digitaria collina** (BALANSA) HENRARD nov. comb.

Digitaria campestris HENRARD nom. nov., based upon ARECHAVALETA's *Panicum ramosum* which is not the *P. ramosum* of L., it is allied to the *Digitaria aequiglumis* PARODI but has shorter spikelets and differs in the vegetative parts too. I saw a very beautiful specimen in HACKEL's herbarium, quite agreeing with ARECHAVALETA's plate.

Digitaria mollicoma (KUNTH) HENR. nov. comb. = *Paspalum mollicomum* KUNTH, = *Paspalum molle* PRESL non POIRET.

Digitaria polyphylla HENRARD nom. nov. = *Digitaria foliosa* STENT. non Lagasca. South Africa.

Digitaria Stentiana HENRARD nom. nov. = *Digitaria glauca* STENT. non CAMUS. South Africa.

Digitaria dispar HENRARD nom. nov. = *Panicum heteranthum* NEES et MEYEN (1843) non LINK (1827).

Digitaria latronum HENRARD nom. nov. = *Digitaria marianensis* MEZ (1924), non *Digitaria mariannensis* MERRILL (1914).

Digitaria Dinteri HENRARD nov. spec. Perennis, dense caespitosa, innovationes extravaginales, basi squamis villosis cinctae, erectae. Culmi simplices, stricte erecti, glabri, striati, vix sulcati, pedunculo paniculaeque ad 60 cm. alti vel interdum tantum ad 30 cm. longi, subuninodes, nodo superiore in $\frac{1}{6}$ inferiore culmi sito, internodio infimo circa 10 cm. longo, supremo (pedunculo) longissimo; squamae basales valde striatae, appresse

hirsutae, ovato-lanceolatae vel lanceolatae. Folia fere omnia in basi culmi aggregata, vaginae innovationum compressae, culmeae subcompressae vel subteretiusculae, aretae, interdum subcarinatae, multinervosae, inter nervos hirsutae pilis patentibus rigidis longissimis, basi tuberculatis praeditae, vaginae foliorum culmeorum internodiis circa duplo breviores, nodis minute pubescentibus vel glabris, supra nodos annulo dense piloso praeditae; ligula brevis, circa $\frac{1}{2}$ mm. longa, longe firmbriata, auriculae lateraliter barbatae. Folia pallide glauca, laminae planae, eae culmorum circa 2 mm. latae, haud longae, eae innovationum paulo angustiores, circa 15 cm. vel plus longae, sensim longe setaceo-acuminatae, multinervosae, nervo mediano albo crassiusculo valde prominulo percursae, marginibus albis incrassatis haud flexuosis, subseaberulis praeditae, undique pilis rigidis patentibus basi tuberculatis hirsutae; pedunculus longe exsertus, gracilis, striatus, subseaberulus, viridis vel viridi-violascens; racemi digitati vel secus axin communem ad 1 cm. longum solitarii vel superiores digitati, erecti vel erecto-patuli, vulgo ad 6 cm. longi, densiflori, a basi breviter nudi, ad insertionem incrassati ibique densiter pubescentes vel villosi, axis communis triquetrus, seaberulus, racemi circa 6 (—4), aequales, rhaehi spiculis angustiore, anguste viridi-marginata, subtrigona, angulis scabra; spiculae binatae, pedicellis subteretibus seaberulis apice leviter patellatis, altero spiculam aequante, altero ea quadruplo brevior fultae, lineari-lanceolatae, circa 2.2—2.4 mm. longae, longe pilosae, pilis ultra apicem glumae productis et tunc spiculae 2.8—3 mm. longae; gluma inferior triangulari-acuta, brevissima, purpurascens, circa 0.3 mm. longa, enervis, gluma superior subulato-lanceolata, 3-nervis, spicula $\frac{1}{3}$ brevior, ea paulo angustior, inter nervos et versus margines densissime longe villosa, villis copiosis, porrectis, ultra apicem glumae ita productis ut gluma fertilis totaliter obtecta sit, nervis haud vel vix visibilis, gluma III sterilis 7-nervis, lanceolata, villosissima, ciliis porrectis ultra apicem glumae penicillatim productis, gluma circa duplo brevioribus, albo-purpurascens; gluma IV fertilis spiculam subaequans, circa 2 mm. longa vel paulo longior, lanceolata acuta vix acuminata, viridula, minute puncticulato-striolata.

GREAT NAMALAND, South West Africa: Windhoek, 1600 m.s.m. april 1912. leg. K. MÜLLER in Herb. DINTER no. 2573. Typus in H. L. B.

Other specimens seen: Great Namaland; DINTER no. 4479 (Herb. Berlin). Huib plateau, between Ausis and Khuias in 1855 leg. SCHENCK (HACKEL herb. Vienna.)

Baron FERDINAND VON MUELLER indicated in his *Fragmenta Phytographiae* from the year 1874 a *Panicum autumnale*. His type was the plant from Sweer's Island, collected by HENNE. BENTHAM placed this plant as a var. *lelostachyum* under *Panicum papposum* R. BR. It is however widely different from the latter and very different from the american plant too. The species is taken up in my work as **Digitaria Benthamiana** HENRARD, nom. nov.

The genus *Trichachne*, as accepted by American agrostologists, is treated in my monograph very extensively, to demonstrate that the characters for separating this genus are very inconstant and insufficient to maintain the genus if we study the *Digitarias* of the world. Properly spoken the genus is as to its habit only restricted to the New World. The australian species *Digitaria Brownii* (R. ET S.) HUGHES, which has the long villous spikelets too, is a true *Digitaria* and *D. tricholacnoides* STAPP from South Africa (which is *Panicum tunicatum* HACK.) has still a more beautiful dense tomentum on the spikelets, it is in the fertile lemma and other characters of the fruit however a *Digitaria*. The long acute fruit of the typical *Trichachne insularis* is not observed in some other American species of *Trichachne*. The stipitate fruit of the genus *Trichachne* occurs also in true *Digitarias*. For a local flora the genus *Trichachne* is to limit, but, as is already said, going over all the *Digitarias* of the world, no constant character is found and the consequence is therefore that we have to unite *Trichachne* and *Digitaria*.

STAPP, HUGHES and others did not accept the genus *Trichachne* for Tropical and South Africa and Australia. I formerly accepted *Trichachne* as a genus, but found it afterwards impossible to define it sharply and all attempts, even those of Mrs. A. CHASE, in her beautiful work on the *Paniceae*, have failed. The different species formerly accepted in the genus *Trichachne* are not easy to separate, they are for the moment taken up as **Digitaria insularis** (L.) MEZ, **D. sacchariflora** (RADDI) HENR., **D. californica** (BENTH.) HENR., **D. patens** (SWALLEN) HENR., **D. tenuis** (NEES) HENR., **D. Hitchcockii** (CHASE) STUCKERT, **D. Sellowii** (MÜLLER) HENR., and **D. laxa** (REICHB.) PARODI.

Digitaria Neesiana HENRARD nom. nov. = *Trichachne velutina* NEES, non *Digitaria velutina* P. B. nec HITCHCOCK. = *Panicum vestitum* KUNTH, non *Digitaria vestita* FIGARI et DENOTARIS. Brazil.

Digitaria Pittieri (HACKEL) HENRARD nov. comb. = *Panicum Pittieri* HACKEL, = *Valota Pittieri* (HACK.) CHASE.

Milium tomentosum KOENIG was described by WILLDENOW in the year

1803, the same species was published by ROTH in the year 1817 in ROEMER and SCHULTES's *Systema Vegetabilium* as *Milium capillare*; TRINIUS published it as *Panicum subeglume* and STEUDEL applied to it WIGHT and ARNOTT's name *Panicum Browneanum*. Wight no. 3037 is as to the characters of the spikelets and the fruits a *Digitaria*, both glumes are present only as rudiments. I have therefore named the species ***Digitaria tomentosa*** (KOEN.) HENR. nov. comb.

The species is only known from British India and is in its technical characters somewhat allied to *Digitaria thyrsoides* BALANSA and *Digitaria quinhonensis* GAMUS which have a very distinct upper glume and are in their panicles intermediate between *Leptoloma* and *Digitaria*, the former genus is not accepted in my work.

Digitaria jubata (GRISEBACH) HENR. nov. comb. = *Paspalum jubatum* (GRISEBACH). Is accepted by HOOKER as distinct from *Digitaria pedicellaris* and I am of the same opinion. Even if we unite the two species the name given by GRISEBACH has priority.

Two species from British India are characteristic members of the „*Binata*”; they were described by HOOKER as varieties under his *Paspalum sanguinale* but treated by me as distinct species.

Digitaria Griffithii (ARNOTT) HENRARD nov. comb. = *Paspalum sanguinale* HOOKER, var. *Griffithii* HOOK. f.

Digitaria extensa (NEES et ARNOTT) HENRARD nov. comb. = *Paspalum sanguinale*, var. *extensum* HOOKER f.

Digitaria caledonica HENRARD nov. spec. Caespitosa, striete erecta, radicibus tenuibus, innovationibus paucis, rhizoma deest, probabiliter annua vel biennis, hinc inde squamulis ad basin culmi praedita; culmi teretes, glaberrimi, superne subangulati, stricti, cum panicula ad 40 cm. alti, circa 5-nodes, nodo summo in medio culmo vel infra medium sito, nodis glabris; vaginae glabrae, inferiores inter nervos scaberulae, superiores glaberrimae, compressiusculae, internodia superantes, ligula abbreviata, 1—1½ mm. longa, albo-fusca, hyalina, obtusa, scariosa; laminae e basi subaequilata lineari-lanceolatae, vulgo 10—12 cm. longae, ad 5 mm. latae, sensim acutatae, utrinque glabrae vel subscaberulae, marginibus vix inerasatis, multinervosae, nervo medio albo crasso praesertim inferne conspicuo praeditae, apice leviter, ob marginibus involutis, contractae, haud pungentes, pedunculus inflorescentiae longe exsertus, glaberrimus, striatus; panicula bene digitata, cuneata, 9—11 cm. longa, axis communis abbreviatus, 1½—2½ cm. tantum longus, canaliculato-striatus, glaber, racemi erecto-adscendentes vel stricti, solitarii vel interdum sub-

binati, inter se distantes, simplices, inferiores paniculum aequantes, superiores sensim decrecentes, rhaehi recta spiculis subaequilata, nervo medio crasso praedita, bene viridi-marginata, marginibus scaberulis; spiculae vix $1\frac{1}{2}$ mm. longae, ternae vel ad basin racemorum quaternae, propter pedicellum primarium basi adnatum binae et solitariae, glaberrimae, pedicelli abbreviati, subteretes, subscaberuli, parum inaequilongi, spicula breviores, gluma inferior deest vel vix indicata, gluma superior spicula $\frac{1}{3}$ brevior, ea haud angustior, bene late rotundata, 1 mm. longa, convexa, 3-nervis, nervo medio percurrente, lateralibus apice anastomosantibus, gluma III plana, spicula paullo brevior, apice etiam rotundata, 3—5-nervis, nervis 3 vulgo crassioribus sub apice nervo medio anastomosantibus, spiculae subsessiles (secundariae et tertiae) vulgo 3-nervis, spiculae longiter pedicellatae (primariae) vulgo 5- vel 4-nervis, gluma IV (fertilis) ovato-lanceolata, bene acutata sed haud vel vix acuminata, apice exserta et bene visibilis, convexa, striolato-puncticulata, atropurpurea.

NOVA CALEDONIA: Nouméa; legit BALANSA 1868—1870 no. 1730 sub nom. *Paspalum brevifolium* FLUEGGE. Typus in H. L. B.

Allied to this new species are two australian ones, neglected since they were described:

Digitaria patula (HORNEMANN) HENR. nov. comb. = *Paspalum patulum* HORNEMANN.

Digitaria ramularis (TRINIUS) HENRARD nov. comb. = *Panicum ramulare* TRINIUS.

Digitaria Thwaitesii (HACKEL) HENR. nov. comb. = *Panicum Thwaitesii* HACKEL. Ceylon.

Digitaria tricostulata (HACKEL) HENR. nov. spec. = *Panicum puberulum* KUNTH, var. *tricostulatum* HACKEL. Natal.

Digitaria livida HENR. nov. spec. Perennis, caespitosa, innovationibus extravaginalibus, basi squamis aphyllis hirsutis, valde nervosis praedita; culmi erecti vel inferne subadscendentes, striato-sulcati, cum panicula circa 60 cm. alti, sat validi, circa 3-nodes, nodo summo in medio culmo sito, nodis glabris; vaginae internodiis paulo longiores vel paulo breviores, valde nervosae, teretiuseculae, superne hiantes, superiores glaberrimae, inferiores praesertim superne pilis longis, sparsis, rigidis, basi tuberculatis praeditae, marginibus subhyalinis angustis; ligula brevissima, 1 mm. longa, hyalina, glabra vel minute pubescens, apice distincte ciliata, auriculae incrassatae, brunneae, haud raro productae; laminae obscure virides, lividae, inferne subearinatae, nervo mediano albo crasso

supra et subtus bene prominulo praeditae, circa 4–5 mm. latae, e basi aequilata lineares, sensim angustatae, apice leviter convolutae quasi setaceae, ad 15 cm. longae, marginibus albis undulatis, incrassatis, laevibus, vel minute scaberulis praeditae, glabrae vel inferne ad basin pilis nonnullis albis, longis, basi tuberculatis, obsitae; pedunculus strictus, teres, crassus, striatus; panicula erecta, axis communis circa 1½ cm. longus, racemi circa 8, digitati, porrecti, in axillis pubescentibus, sessiles, subaequilongi, ad 10 cm. longi, virides, dense spiculati, spiculis imbricatis, rhachi recta, spiculis subaequilata, 0.6 mm. lata, valide albo-striata, margine viridi latitudine striae cineta, margine scabra; spiculae binae, pedicellis scabris, triquetris, altera pedicello ipsa subaequilonga, altera ipsa multo brevior fulta, virides, lineari-lanceolatae, acutae, superne leviter sed distincte acuminatae, 3–3.2 mm. longae, gluma inferior parvula, triangulari-acuta, enervis, glabra, superior spicula $\frac{1}{5}$ brevior, vel haud raro spiculam subaequans, lanceolata, 3-nervis, inter nervos et versus margines longe porrecte villosa, gluma III sterilis 7-nervis, nervis aequidistantibus, dorso subglabra, juxta nervum medium glabra, marginibus dense longiter adpresse villosa, villis vix ultra apicem glumae exsertis, gluma IV fertilis viridi-purpurascens, spiculam subaequans vel eam paulo brevior, lanceolata, acuta, minute puncticulato-striolata.

SOUTHERN RHODESIA: Matabeleland; District Belingwe, Gold Fields (southeast of Bulawayo) leg. POTTENSY, 11. 2. 1932 no. 5503, ex Government Herbarium Salisbury, southern Rhodesia. Typus in H. L. B.

Digitaria lancifolia HENR. nov. spec. Culmus — in specimine basi incompletus — decumbens, demum adscendens, plurinodus, e nodis inferioribus ramosus, ramis sterilibus elongatis erectis, ad nodos glabros radicans; internodia ad basin culmi 3 cm. longa, sensim accrescentia, glaberrima, compressa, carinata, leviter striata, purpurascens; vaginae internodiis breviores, laxiuseulae, hiantes, apice a culmo solutae vel eae ramorum aetae, multinervosae, plus minus carinatae, inter striis hirsutae, pilis basi tuberculatis, praesertim ad margines, ligula fusca, membranacea, glabra, lacera, abbreviata, truncata, circa 1 mm. longa; laminae e basi subeordata lanceolatae, sensim acutatae sed haud acuminatae, 5–7 cm. longae, circa 1 cm. latae, multinervosae, nervis primariis circa 11, subaequidistantibus, crassiusculis pereursae, nervis secundariis numerosis indistinctis, nervo medio crasso albo valde prominulo, scabrae, pilis longis sparsis basi tuberculatis praeditae, marginibus crispis leviter incrassatis, flaccidae; panicula erecta, longe pedunculata, pedunculo circa 20 cm. longo, nudo, glabro, striato, inflorescentia flabellata, bene bipinnata circa

17 cm. longa, siccando ad 15 cm. lata, axis 10.5 cm. longus, glaber, canaliculatus, superne in racemum erectum, 5 cm. longum abiens, racemi erectopatuli, numerosi, ad basin paniculae verticillati, superne binati vel solitarii, subaequidistantes, inferiores inferne regulariter pinnati, ad 14 cm. longi, ramulis erecto-patentibus ad 4 cm. longis, superiores sensim decrescentes et in racemum simplicem abeuntes, ramuli etiam subaequidistantes, racemi ultimi minus ramosi vel simplices, spiculae et ramuli in paniculam aequaliter vel subaequaliter dispositae, rami ramulisque triquetri, angustissime vel vix marginati, scabri, in axillis puberuli, racemi hinc inde prope basin pilis albis paucis praediti; spiculae erectae, inferne haud raro 4—5-natae, superne ternatae, summae binatae, pedicellis inaequilongis, longiores 2—3 mm. vel plus longae, breviores haud raro vix 1 mm. longae; spiculae vix 2 mm. longae, vix $\frac{3}{4}$ mm. latae, linearilanceolatae, viridi-purpureae, gluma inferior adest, triangularis, $\frac{1}{10}$ spiculae aequans, glabra, gluma superior concava, spiculam brevior, circa 1.4 mm. longa, ovata, acuta, 3-nervis, inter nervos et versus margines pilis adpressis praedita, gluma III (fertilis) spiculam aequans, apice cucullata, circa 5-nervis, juxta nervum medium glaberrima, cetera pilis adpressis ut in II praedita, gluma IV leviter acuminata, punctulato-striata, purpurascens.

AFRICA ORIENTALIS: Nyassa Hochland, Station Kyimbila, 16—1800 m.s.m. leg. A. STOLZ no. 1237. 3/5. 1912. Typus in H. L. B.

Digitaria tangaensis HENR. nov. spec. Perennis, longe repens, stolonibus crassis, multinodis, squamosis praedita, squamis multinervosis, inter nervos minute puberulis; culmi sine paniculis ad 50 cm. longi, plurinodes, subcompressi, striati vel canaliculati, glaberrimi, nodis glabris; vaginae valde striatae, carinatae, glabrae, inferiores internodiis longiores, summae interdum valde elongatae, hiantes, ligula glabra, truncata, abbreviata, vix $\frac{1}{2}$ mm. longa; laminae lineares, subtus carinatae, tenuinerves, nervo medio valde prominulo, glabrae, marginibus undulatis subincrassatis, planae, 3—4 mm. latae, valde inaequilongae, circa 10 cm. vel haud raro multo longiores, superne ad apicem leviter involutae et sensim acuminatae; inflorescentia 8—9 cm. longa, pedunculo glabro circa $\frac{1}{2}$ mm. crasso; panicula e racemis circa 8 formata, rhachi communi 3—5 cm. longa, inferne teretiuscula, striata, superne valde sulcata vel canaliculata, glabra, ramis solitariis vel interdum hinc inde geminatis, remotis. Racemi inferiores paniculae ad 5 cm., superiores ad 4 cm. lg., omnes gracillimi, laxiflori, dorso plani, ventre carinati, marginibus vix alatis, rhachi quasi trigona, glaberrima, ad insertionem vix vel minutissime puberula. Spi-

culae binae, pedicellis tenuibus, teretibus, laevibus, apice leviter patellatis, altero spiculam aequante vel subaequante, altero eam plus quam triplo brevior fultae, spiculae 2 mm. longae, vix $\frac{3}{4}$ mm. latae, pallide brunneae, lineari-lanceolatae, gluma I spicula 6-plo brevior, triangulari-ovata, enervis, glabra; II spicula distincte sed paullo brevior, lanceolata, apice rotundata, herbaceo-membranacea, quiquenervis, nervis ut videtur haud anastomosantibus, haud excurrentibus, inter nervos medianos brevissime longitudinaliter puberula, versus margines breviter ciliolata; gluma III spiculam aequans, lineari-lanceolata, acuta, elevate 5-nervis, nervis aequidistantibus, juxta nervum medium glaberrima, ceterum longitudinaliter puberula; gluma IV (fertilis) spiculam aequans, lineari-lanceolata, acuminata, punctulato-striata, scaberula, violascens.

AFRICA ORIENTALIS: Kigombe in districtu Tanga. B. L. Institut Amani. no. 1613. leg. († SCHOLZ. 5. 1. 1908. Typus speciei in Herb. Berolinensis.

Digitaria proxima HENR. nov. spec. Perennis, probabiliter caespitosa, culmi erecti, simplices, circa 4-nodes, superne longe nudi, basi squamis villosis praediti, glabri, lateraliter compressi, longitudinaliter sulcati vel superne striati, nodis patentim barbatis, nodo summo circa medium culmi sito; vaginae aetae vel lateraliter compressae, dense striatae, superne plus minus hiantes, inferiores breviores, internodiis longiores, superiores valde elongatae, patule villosae vel pubescentes, pilis basi tuberculatis, ligula glabra, lacera, fulva, basi pilis stipata; laminae lineari-lanceolatae, multinervosae, nervo medio subtus valde prominulo, marginibus scabris undulatis parum incrassatis, ad 5 mm. latae, ad 15 cm. longae vel inferiores breviores, subadpresse vel patule villosae, sensim acutatae, apice leviter involutae; inflorescentia longe pedunculata, pedunculus teres, striatus, interdum ad 50 cm. longus, praesertim superne pilis albis longis sparsis patentibus praeditus; panicula densa, contracta, cuneata, ad 20 cm. longa, axis elongatus, inferne subearinatus, superne angulatus, scaber, hinc inde ut in pedunculo, pilis albis ornatus; racemi numerosi, omnes gracillimi, laxiflori, inferiores ad 12 cm. longi, superne sensim deerescentes, in axillis pubescentes et hinc inde praesertim ad basin pilis longis praediti, rhachi trigona, dorso applanata, ventre carinata, anguste marginata, scabra; pedicelli bini vel ad basin racemi terni vel quaterni, scabri, trigoni, alter spiculam aequans vel superans, alter ea triplo vel plus brevior; spiculae lineari-lanceolatae, viridi-purpurascens, $2\frac{1}{2}$ mm. longae, circa $\frac{3}{4}$ mm. latae, acutae sed haud acuminatae, gluma inferior deest vel vix evoluta, gluma II et III aequilongae, II 7-nervis, inter nervos et versus margines pilis adpressis vestita, gluma IIIa

7-nervis spiculam aequans, juxta nervum medium glabra, gluma IVa spiculam aequans, lineari-lanceolata, acuminata et distincte apiculata, convexa, punctulato-striata, scaberula, livide violascens.

AFRICA ORIENTALIS: District Uhehe, Iringa, prope Kambi ya mboga. Amani Institut no. 2603. leg. ZIMMERMANN 20.2.09. Typus speciei in Herb. Berlin.

Digitaria Zeyheri (NEES) HENR. nov. comb. = *Panicum Zeyheri* NEES, Fl. Afric. austr. (1841). The *Digitaria horizontalis*, as described by WILLDENOW from the New World, was accepted by STAFF as an inhabitant of tropical Africa. The east African plants from Abyssinia and South Africa differ in important characters from the New World plants, the latter have a very distinct lower glume and an upper one $\frac{1}{2}$ as long as the spikelet. The specimens from Abyssinia and the plants described as *Panicum Zeyheri* have a wanting or much reduced lower glume and a much longer upper one, $\frac{2}{3}$ as long or nearly as long as the length of the spikelet. Such plants were described (or issued in exsiccatae by HOCHSTETTER) as *Panicum psilostachyum* HOCHST. (Schimper 2256); *Panicum horizontale* RICHARD (Schimper 1618); *Panicum fenestratum* HOCHST. (Schimper 85) and *Panicum Zeyheri* NEES (Drège). It is noteworthy that the very accurate NEES did not mention the true *Digitaria horizontalis* from South Africa and described only 2 varieties (*glabriusculum* and *subcompositum*). His *P. Zeyheri* was indicated as having an obsolete lower glume and an upper one $\frac{1}{3}$ shorter than the spikelet, two important differences with the actual *D. horizontalis*. Accepting the east african plants as a succedaneous species of the *D. horizontalis*, I have given it the earlier name published by NEES. Some abyssinian plants of HOCHSTETTER may represent once more a different species as *D. fenestrata* RENDLE.

Digitaria Gardneri HENR. nov. spec. Annua, florendi tempore innovationibus nullis. Culmi stricti erecti, longissimi, simplices, circa 5—6-nodes, nodis glaberrimis, nodo summo circa prope medium culmi sito, cum panícula plus quam 1 m. alti, teretes, vel supernè subcompressi, glaberrimi; vaginae striato-sulcatae, inter striis pilis basi tuberculatis obsitae, internodiis longiores, apice vulgo hiantes vel partim a culmo solutae, ligula brevissima, vix 1 mm. longa, puberula, apice subscariosa, pilis longis stipata; laminae e basi subaequilata lineares, complicatae, explicatae 3—4 mm. latae, 15 cm. vel plus longae, erectae, multinervosae, nervo mediano crasso valde prominulo praeditae, nervis primariis subaequalibus crassiusculis percursae, secundariis tenuissimis, marginibus

seabris haud incrassatis, pagina superior pilis sparsis praesertim inferne praedita, pedunculus teres, elegans, longissimus, inflorescentia erecta, cuneata, subfastigiata, racemi circa 6, secus axin communem ad 5 cm. longum solitarii vel superiores oppositi, axis teretiuseculus, scaber, racemi ad 15 cm. longi, vel superiores circa 12 cm. longi, inferne sublaxiflori, superne subdensiflori, in axillis pilosi, rhachi trigona, spiculis multo angustiore, scabra, vix vel angustissime viridi-marginata, marginibus scabris, spiculae vulgo ternatae, pedicellis tenuibus, linearibus, scaberri-
mis, vix patellatis, primario spiculam multo superante, secundario et tertiaro pluries brevior fultae, racemi inferiores ad basin quasi ramosi, ibique racemuli secundarii formantes et tunc 5—6-ni, spiculae 2 mm. longae, 0.7 mm. latae, ovato-lanceolatae, leviter sed distincte acuminatae, gluma inferior deest vel margo indistincto indicata, gluma superior spicula circa $\frac{1}{4}$ brevior, lanceolata, acuta, 3-nervis, pilis longis undique villosa, pili ultra apicem glumae producti, gluma III spiculam aequans, circa 5-nervis, juxta nervum medium glabra, ceterum adpresse pilosa, pilis strictis, sat rigidulis, fulvis, vel rufidulis, apice non clavatis, porrectis, ultra apicem glumae subpenicillatim productis, gluma IV (fertilis) 1.8 mm. longa, apiculata, distincte puncticulata, atro-purpurea.

BRASILIA: Piahy in 1839 leg. GARDNER no. 2340. Typus speciei in Herb. Lugd. Bat. sub no. 934. 121—149.

In the group of the annual *Ternata* very characteristic by the stiff, rather rigid rufous hairs on the sterile lemma.

Digitaria villiculmis HENR. nov. spec. Probabiliter annua, sed tempore florendi innovationibus sterilibus paucis munita. Culmi cum paniculis ad 45 cm. alti, striete erecti, binodes, nodis constrictis, villosis, nodo summo infra medium culmi sito, internodia dense erecto-adpresse villosa, pilis basi tuberculatis, pedunculus exsertus, sulcatus, longe patenter pilosus, pilis sordide albis vel subrufidulis; vaginae striatae, dense adpresse villosae, internodiis breviores, ligula vix 1 mm. longa, glabra, hyalina, superne fusca, scariosa; laminae e basi subaequilata lineares, sensim subsetaceo-acutatae, inferiores angustae, 8—9 cm. longae, culmeae planae, multo longiores, interdum 20 cm. longae, ad 3 mm. latae, undique dense villosae, nervo medio prominulo crasso, nervis secundariis distinctis praeditae, marginibus leviter involutis; inflorescentia erecta, e spicis duabus formata, racemus inferior circa 6 cm. longus, sessilis, erecto-patens, superior circa 9 cm. longus, striete erectus, pedunculatus, pedunculo $1-1\frac{1}{2}$ cm. longo, angulis villosis, racemi ad insertiones villosi; spiculae ternatae subdense imbricatae, rhachi trigona, villosa, vix viridi-

marginata, angulis scaberulis, pedicelli scabri, triquetri, ad apicem distincte patellati, sparse longeque pilosi, pilis superioribus ultra apicem excedentibus, pedicellus primarius spiculam circa duplo superans, secundarius eam subaequans, tertiarius illa circa duplo brevior; spiculae ovato-ellipticae, 1.8—1.9 mm. longae, circa 1 mm. latae, undique pilis brevibus distincte clavatis dense puberula, gluma inferior deest vel vix distincta, gluma superior spicula paullo brevior, 3-nervis, apice rotundata, gluma III spiculam subaequans, ovali-elliptica, obtusa, 5-nervis (vel sub-7-nervis), gluma IV spiculam aequans, subaeuminata, apiculo distincte exserto, valde convexa, seriato-punctata, atropurpurea.

VENEZUELA: Biscaina prope coloniam Tovar. legit A. FENDLER no. 1740. Typus in herb. Vindebonensis sub no. 22949.

A very characteristic species of the group of the „*corynotrichae*” all belonging to the Ternata, with densely puberulous spikelets, the short hairs capitate. In this group the species is striking by the villosity of all the vegetative parts, especially the internodes.

The only other species with such villous internodes is *D. corynotricha* (HACK.) HENR. from Brazil, a more robust perennial plant with sheaths much longer than the internodes, longer blades, about 1 cm. broad, more racemes, glabrous rhachis of the racemes and longer spikelets.

Digitaria Lehmanniana HENR. nov. spec. Annua, radicibus tenuibus; culmi cum paniculis ad 60 cm. alti, ventre valde canaliculati, erecti, graciles, vel geniculato-adscendentes, basi ramosi, paucinodes, nodis glabris, internodio summo longissimo; vaginae inferiores internodiis parum longiores, striatae, scaberulae, haud pilosae, teretiuseculae vel carinatae, ligula interdum ad 2 mm. longa, vulgo 1 mm. longa, albo-fusca, glabra, apice lacera, pilis nonnullis stipata; laminae e basi subrotundato-cordata lineares, sensim acutatae, ad 6 cm. longae, ad 5 mm. latae, sed vulgo multo breviores et angustiores, nervo mediano albo crasso percursae, marginibus albis crassiusculis undulatis praeditae, pedunculus strictus, glaber; inflorescentia subpaniculata, axis communis circa 5—6 cm. longus, inferne teres, superne angulatus, glaber, racemi elegantes, inferne solitarii, superne subbinati, subaequaliter remoti, 5—8 cm. longi, superne sensim decrescentes, ad basin (praesertim inferiores) ramulosi, ramulis interdum ad 2 cm. longis, in axillis breviter pubescentes, rhachi scabra, trigona, non vel vix marginata, spiculis multo angustiore, pedicelli erecti, leviter flexuosi, scabri, triquetri, ternati vel superne binati, inferne ad basin racemorum 4—6-ni, valde inaequilongi, pedicelli longiores spiculam 2—3-plo superantes; spiculae perfecte glaberrimae, pusillae, 1.2—1.3 mm.

longae, ellipticae, gluma inferior deest, gluma superior apice subrotundata, 3-nervis, nervis infra apicem anatomosantibus, spicula distincte brevior, gluma III spiculam subaequans, subobtusata, nervis 7 subaequidistantibus praedita, gluma IV apiculata, apiculo distincte exserto, violacea, longitudinaliter lineolato-puncticulata.

COLUMBIA: Forests of highlands of Popayan, 1500—2000 m. leg. LEHMANN in 1886 sub no. B. T. 632. Typus in Herb. Lugd. Bat. sub no. 908, 349—559.

Allied to the old world *Digitaria pedicellaris*, but distinguished by the smaller glabrous spikelets, also allied to the *D. curvinervis*, an annual too, which has however a very short common axis, simple, not branched racemes and a shorter second glume. The same species was collected by Prof. L. R. PARODI in Bolivia: La Florida, Sur Yungas, 1700 m. in the year 1932 in coca plantations (Parodi no. 10058 bis).

Digitaria sabulicola HENR. nov. spec. Annuæ, caespitosa; culmi erecti, elegantes, circa 3-nodes, vaginae inferiores dense villosae, pilis horizontaliter patentibus, vel ad nodos reflexo-barbatae, vaginae internodiis breviores, laminae inferiores breves, planae, latae, villosae, nervo mediano albo crasso, marginibus albis undulatis vel rectis haud vel parum inersatis, ligula scariosa, truncata, glabra, stramineo-fulva; pedunculus inflorescentiae elegans, striatus, glaber, panicula e racemis 3—4 formata, in axillis pubescens, racemi laxè floriferi, strictè erecti, rhachis anguste marginata, triquetra, scabra; spiculae binatae, pedicelli triquetri, scabri, apice subcupulati, spiculae virides, erectae, circa $2\frac{1}{4}$ mm. longae, angustae, acutae, vel leviter acuminatae, gluma inferior deest, gluma II 3-nervis spicula paulo brevior, gluma III 5- vel sub-7-nervis, nervis aequidistantibus, gluma IV pallida, acuta, leviter striolata.

Rather densely caespitose plant, forming small tufts, culms together with the panicle 30—40 cm. high, thin, rather few-noded, nodes about 3, internodes terete, the lower ones short, scarcely 1 cm. long, glabrous, gradually becoming longer, the uppermost one (peduncle) very long, exserted, the upper node below half the length of the whole plant, upper nodes glabrous; sheaths densely villous especially the lower ones, with horizontally spreading hairs or the lower nodes bearded with reflexed hairs, the minutely thickened bulbous-based hairs as long as the diameter of the sheath, the leaves thickly velvety, the hairs concealing the nerves, upper leaves becoming narrower and more glabrous, the uppermost blade only up to 1.5 cm. long and scarcely 1 mm. wide, the normal blades in the lower part of the plant about 5 cm. long and 2 mm. broad,

slightly inrolled at the top and quasi pointed or acuminate, ligule scarcely 2 mm. long, peduncle very thin, racemes up to 6 cm. long, solitary, the internodes of the panicle 5—7 mm. long, axis very narrowly winged, almost triquetrous, thin, scabrous, spikelets paired, one nearly sessile, the other pedicelled, the pedicel about 2 mm. long and triquetrous, scabrous, with a slightly discoid tip, spikelets narrowly acute, narrowed at both ends, slightly acuminate, glume I wanting or a rim only, glume II a little shorter than gl. IV, which is a little shorter than the sterile lemma, the nerves of gl. II and III are scabrous and there is a very fine pubescence along the margins of both, the fertile lemma is yellowish, acute and finely striolate.

BRASILIA: Provincia de Espiritu Santo. Voyage d'AUGUSTE DE SAINT-HILAIRE, de 1816 à 1821. Catal. B 2, 2me part. no. 369. Typus speciei in Herb. Mus. Paris.

Digitalia Petelotii HENR. nov. spec. Perennis, culmi erecto-adscendentes, vel decumbentes, ad nodos repentis, multinodes, internodiis dense pubescentibus, pedunculus glaber, nodi adpresse pubescentes; vaginae nervosae, pilis basi tuberculatis praeditae, internodiis breviores, marginibus hyalinis, ligula abbreviata, ciliolata, laminae planae, 4—5 cm. longae, 3—5 mm. latae, marginibus incrassatis, panicula e racemis 2—5 formata, rhachi distincte viridi-marginata; spiculae albo-virides, adpresse villosae, ternatae, pedicelli teretes, glaberrimi, apice cupulati, circa 2.5 mm. longae, 0.8 mm. latae, lanceolatae, gluma inferior deest, superior et gluma III aequilongae, spiculam aequantes, gl. II 3-nervis, inter nervos et versus margines sericea, gl. III 5—7-nervis, versus margines villosa, nervis subaequidistantibus, gl. IV straminea, leviter acutata, minute striolato-puncticulata.

Perennial species but with a rather faint rootstock with small villous scales at the base, decumbent, sending out long runners that root at the lower nodes, ascending upwards, 30—70 cm. long, the internodes densely pubescent, the lower ones becoming less pubescent at age, the uppermost ones glabrous, especially the peduncle which is glabrous throughout, the nodes are adpressedly rather long pubescent; sheaths strongly nerved with tubercle-based hairs between the nerves, the hairs adpressed or slightly ascending; ligule a very short ciliolate rim only, blades flat, erectly adpressed or somewhat spreading, panicle at least afterwards exerted, the racemes hairy at their insertion, about 10 cm. long, solitarily placed along a short, common, striate or grooved axis, rhachis broadly green-winged with scabrous margins, spikelets ternate, one nearly sessile,

the second with a pedicel shorter than the length of the spikelet, the third with a pedicel as long as or slightly longer than the spikelet, the pedicels nearly smooth or upwards slightly scaberulous, terete, often curved, with discoid tips; spikelets adpressed, the lower glume reduced and a rim only, the upper as long as the spikelet, 3-nerved, adpressedly hairy between the nerves and along the margins, the hairs not overtopping the spikelet, sterile lemma as long as the second glume, glabrous along the midnerve, adpressedly villous laterally and along the margins, hairs verrucose, the fertile lemma pointed, striolate-punctate.

CAMBODGE: Campong Chnang, bords des chemins, juillet 1921, leg. M. PETELOT no. 263. Typus speciei in Herb. Mus. Paris.

A beautiful species, remarkable by its tomentous internodes.

Digitaria manongarivensis A. CAMUS nov. spec. Perennis, laxe caespitosa, innovationibus extravaginalibus; culmi striete erecti, 3—4-nodes, nodis glabris; vaginae internodiis breviores, superne hiantes, subcompressae, albo-striatae, pilis longis albis horizontaliter patentibus, basi tuberculatis dense vestitae, ligula circa 1 mm. vel paulo plus longa, scariosa, denticulata, glabra, sed pilis albis stipata; laminae anguste lineares, sensim subangustatae, marginibus sub apicem involutis et quasi setaceo-acuminatae, undique pilis vestitae, nervo mediano crasso praeditae, praesertim subtus valde prominulo, marginibus albis incrassatis vix scaberulis; pedunculus inflorescentiae longe exsertus subteres vel subcompressus, glaber, racemi circa 2 subconjugati, 7—8 cm. longi, axis triquetrus, elegans, rhachi plana, distincte viridi-marginata, laevis; spiculae ternatae, pedicelli teretes, glaberrimi, apice distincte cupulati, spiculae albo-virides, erectae, circa 2 mm. vel paulo plus longae, lanceolatae, gluma I deest, gluma II et III aequilongae, inter nervis longitudinaliter adpresse villosae, sed pilis haud excedentibus, II 3-nervis, III 7-nervis vel sub-7-nervis, gluma IV straminea, leviter striolata.

Perennial plant with slightly villous scales at the base of the culms, culms subracemose at the base, the internodes from the base to the summit of the culms gradually becoming longer, culms very elegant, about $1\frac{1}{2}$ mm. thick, together with the panicle about 30 cm. high, lower sheaths short, upper ones longer, about 10 cm. long, the lower ones only $4\frac{1}{2}$ cm. long, those of the sterile shoots less than $4\frac{1}{2}$ cm. long, blades 4—7—9 cm. long, about 2 mm. broad or a little narrower, the uppermost leaves of the culms are much reduced, about $1\frac{1}{2}$ cm. long, very narrow and glabrous; racemes about 2, one sessile, the other with a 1 cm. long peduncle, insertion of the racemes pubescent or barbate, spikelets ter-

nate or quasi alternately binate and solitary on account of the third pedicel which is adnate to the midrib, one pedicel very short, the other one longer, the third one the longest. Hairs of the spikelets verrucose.

MADAGASCAR: Herbiere Perrier de La Bâthie. Prés marécageux. Manongarivo (Ambongo) Xre 1904. leg. PERRIER DE LA BÂTHIE no. 11112. Typus speciei in Herb. Mus. Paris.

Digitaria truncata HENRARD et A. CAMUS nov. spec. Perennis, longe repens, culmi ad nodos infimos bulboso-incrassati, multinodes, ibi fasciculatim ramosi, culmi fasciculorum 3-4-nodes, internodio summo longissimo; vaginae et folia glabrae, carinato-compressae, glaucescentes, angustae, circa 5 cm. longae, 11½ mm. latae, nervo mediano vix conspicuo, marginibus albis incrassatis subscaberulis, ligula glabra, circa 1 mm. longa, albo-hyalina, truncata, denticulata; pedunculus inflorescentiae teres, substriatus, glaber, racemi 3 vel 2, digitati, vel 2 sessiles, alter pedunculatus, in axillis leviter pubescentes, 5-6 cm. longi, angusti, rhachi anguste sed distincte viridi-marginata, spiculis angustiore, margine scaberula; spiculae ternatae vel superne binatae, breviter pedicellatae, adpressae, pedicelli inaequilongi, triquetri, scabri, spiculae virides, quasi glabrae, 2½ mm. longae, gluma I distincta, truncata vel emarginato-dentata, gluma II 3-nervis, spiculam aequans, quadriseriatim villosa, marginibus longiter villosis, gluma III (sterilis) spiculam aequans, 5-7-nervis, marginibus tantum villosis, gluma IV (fertilis) flavescens, leviter striolato-punctata.

A long decumbent, creeping perennial plant with a many-noded main culm, the nodes bulbous-thickened, sending out fascicles of sterile and fertile erect shoots of about 10 cm. length, the culms of the fascicles few-noded, nodes only 3-4, the uppermost internode of the fascicles long and exserted, the scales at the base of the fascicles villous; leaves glaucous or more or less violaceous upwards, at the tip somewhat inrolled and setaceously acuminate, fascicles together with the inflorescences about 30 cm. long; peduncle elegant, terete and substriate, glabrous, the 2 or 3 racemes digitate or the central one shortly peduncled, spikelets ternate, or at the top of the racemes upwards binate, the shorter pedicels half as long as the spikelets, the longer ones as long as and the longest twice as long as the flowers. The species is as to the vegetative parts very striking and the fascicles resemble those of the *Digitaria glauca*, the lower, very distinct, truncate glume and the equal glumes II and III are however very different and good characters to recognize the species.

MADAGASCAR: Bevilany (Androy), bords de l'eau, 25 mars 1924. leg.

RAYMOND DECARY no. 2455. Typus speciei in Herb. Mus. Paris.

Digitaria psammophila HENR. nov. spec. Perennis, radix crassa, culmi erecti vel erecto-adscendentes, innovationibus extravaginalibus, paucis, ad 5 cm. altis, culmi floriferi multinodes, nodis 5—6, glabris; vaginae internodiis longiores vel breviores, vaginae inferiores sparse hirsutae, vel glabrescentes, adpressae vel subhirsutae, ligula circa 2 mm. longa, alba, glabra, truncata vel fissa; laminae subglaucae, lineares, angustae, planae, sensim angustatae, vulgo 2.5 cm. longae, 2 mm. vel vix 2 mm. latae, margine albo, subincrassato, scaberulo, subundulato, multinervosae, sed nervo mediano haud conspicuo, pagina superior hinc inde pilis sparsis praedita; pedunculus elegans, erectus, teres pro ratione plantae, glaber, striatus; panicula erecta subcongesta e racemis 2—4 formata, racemi striate digitati, a basi spiculiferi, ad insertionem leviter incrassati et puberuli, racemi 3.5—5 cm. longi, erecti, subdense spiculati, axis albus, distincte viridi-marginatus, spiculae binatae, pedicello altero subsessili, altero dimidiam spiculam aequans, pedicelli triquetri, scabri, spiculae flavo-virides vel stramineae, gluma inferior distincta, gluma II (superior) $\frac{3}{4}$ spiculam aequans, 3-nervis, inter nervos et versus margines villosula, pilis adpressis, gluma III (sterilis) spiculam aequans, 5—7-nervis, ad margines tantum villosa, gluma IV (fertilis) straminea, leviter striolata.

Perennial with a rather thick rootstock with villous scales at the base, culms with glabrous internodes, the lower sheaths longer than the internodes, the upper internodes much longer, the uppermost ones rather long with sheaths shorter than the internodes, lower sheaths sparingly hirsute, soon becoming quite glabrous, with here and there a few long hairs at the auricles or at the collar, tightly adpressed or slightly gaping at the summit, the culm-nodes perfectly glabrous, the racemes distinctly winged, the margins as broad as the whitish midrib, spikelets 2.5—2.8 mm. long, the fertile valve slightly shorter than the third glume.

MADAGASCAR: Localité Ambovombe, dans les prés sableux, 3 fév. 1931. leg. RAYMOND DECARY no. 8488. Typus speciei in Herb. Mus. Paris.

Digitaria planiculmis HENR. nov. spec. Perennis, laxae caespitosa, innovationibus extravaginalibus, culmi cum paniculis ad 80 cm. alti, ad basin dense villosi-hulbosi-incrassati, striate erecti, 7—10-nodes, nodis subaequaliter dispositis, glabris ut tota planta; vaginae compressae, striatae, internodiis breviores; internodia substriata, distincte compressa, auriculae distinctae, glabrae, ad ligulam connatae, ligula glabra, hyalina, 1 mm. longa, truncata; laminae breves, inferiores 4 cm. longae, superiores longiores, circa 7 cm. longae, e basi subcordata, $2\frac{3}{4}$ —4 mm. latae, mar-

ginibus incrassatis, scaberulis, nervo mediano vix vel subtus tantum conspicuo, laminae subsetaceo-acuminatae, pallide glauco-virides, ut tota planta, pedunculus longe exsertus, compressus vel superne tantum teres, striatus, glaber; inflorescentia e racemis digitatis 3—4 formata, in axillis nigris subpubescentibus vel glabris, racemi longissimi, vulgo ad 10 cm. longi, rhachi distincte viridi-marginata, marginibus scabris, spiculis angustiore; spiculae binatae, altera breve, altera longiter pedicellata, pedicellis scabris triquetris, circa $2\frac{1}{2}$ mm. longae, lanceolatae, gluma inferior adest, gluma II (superior) quam spicula duplo brevior, 3-nervis, minute pubescens, ad margines plus minus villosa, gluma III vulgo 5-nervis, interdum sub-7-nervis, nervis validis, inaequidistantibus, tantum versus margines appresse villosa, gluma IV pallida, leviter striolato-punctata.

Culms with a thick bulbous base, densely obtected with villous scales, which become glabrous when old, nodes rather equally distributed, the uppermost internode the longest, plants nearly glabrous throughout, culms and sheaths much compressed, except the uppermost part of the peduncle, the auricles are distinct and slightly protruding, glabrous and united with the ligule, sometimes there is a single hair at the base of the blades, the latter are mostly less than 4 mm. broad. The species has somewhat the habit of *Digitaria compressa* STAPF, and agrees also in the short second glume, but STAPF's species has a fibrous coat at the base of the culms and the lower glume is wanting there.

MADAGASCAR: environs de la baie de Bombetoke, envers 1906. leg. PERRIER DE LA BÂTHIE no. 11049. Typus speciei in Herb. Mus. Paris.

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MATERIALS TOWARDS A STUDY OF THE FLORA OF THE ISLAND OF NEW GUINEA

by

H. J. LAM (Leiden).

Quoique les données ne soient pas encore suffisantes pour pouvoir dresser une statistique de la flore de cette île et pour la comparer à celles des îles voisines, on verra ---- que l'affinité avec la flore de l'Australie n'est pas aussi grande qu'on croyait autrefois:

(R. H. C. C. SCHEFFER — Ann. d. Jard. bot. de Buitenzorg I, 1876, 1).

Introduction.

It has so often been emphasized that the flora of large tropical islands like New Guinea is still very imperfect, that the impression has been established that the data available should be in a state unapt to produce a conspectus or to procure valuable conclusions. Though it is certainly true that there are still immense plots of land entirely unknown from a botanical (or any other) point of view, and that we know but a part (but most probably more than one half) of the Papuan species of *Pteridophytes* and *Spermatophytes*, I am inclined to think that it is more than anything else the scattered nature of those data, that prevented us from realizing their intrinsic value. The time has come, I think, to pause and to realize what has been done in the past years; to arrange the many uncoördinated data in such an order that, on one hand a comprehensive view may be obtained of what has come to our knowledge and on the other hand the gaps may become apparent. In this way it may be expected beforehand, that our present knowledge, however scanty it may be, may enable us to form some provisional conclusions of not too slight an importance and of not too mean reliability. Especially as far as floristics are concerned it is obvious that, for instance, consideration of one half of a flora will lead to practically the same conclusions as the whole flora would.

In this investigation that is meant to be amplified by more detailed studies later on, I have, first of all, compiled an enumeration of the

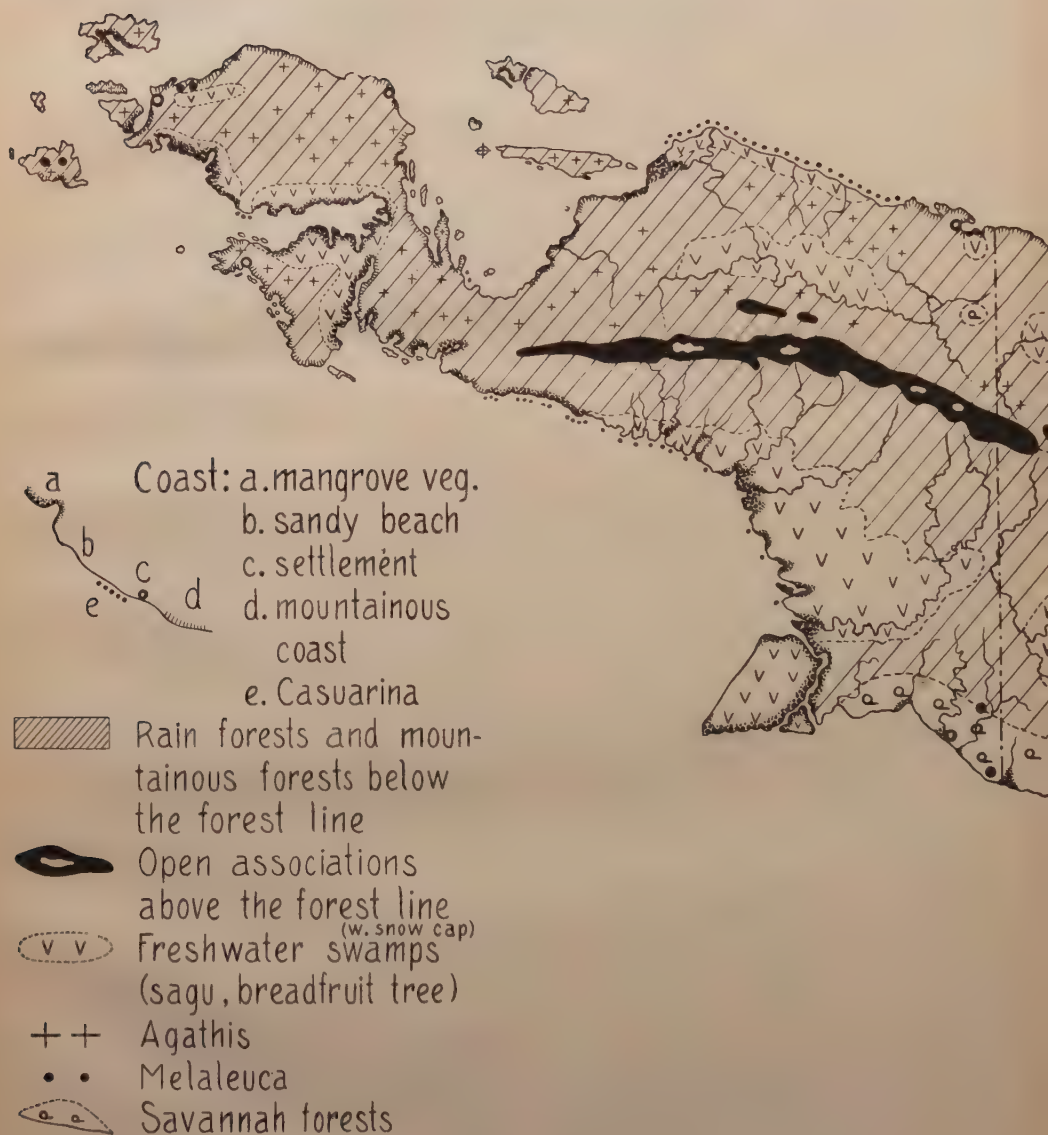


Fig. 1. Principal plan



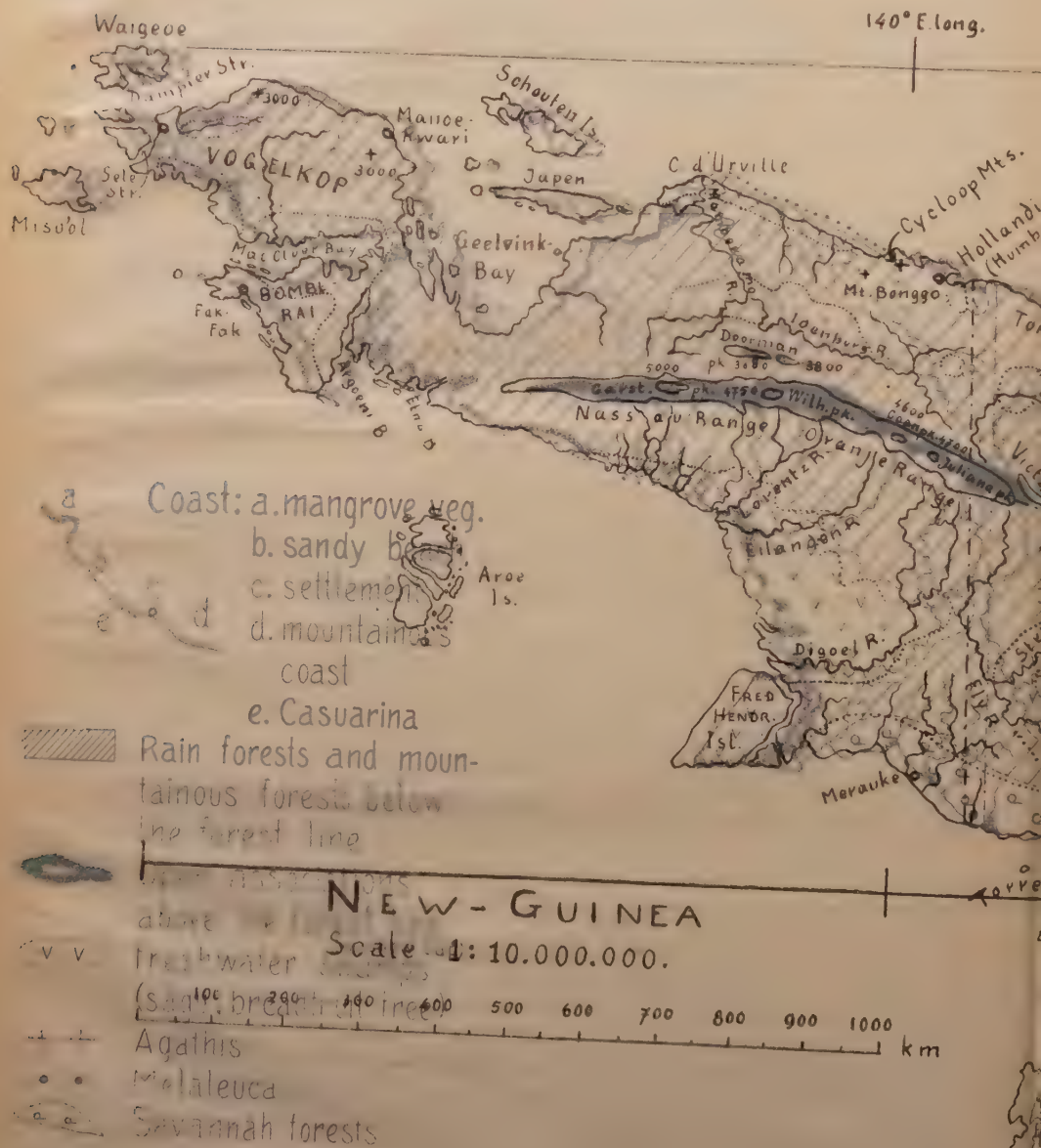


Fig. 1. Principal plant



more important collectors and also of books and papers (cf. Annexes at the end of the present publication) which, together with the literature cited in some of them, may be considered as a basis to any student of the New Guinea flora, who desires to undertake a special investigation in this matter. As far as the facts are concerned my aims have been of a double nature; to get an impression of the principal associations of the island, and to arrange some floristic data in such a way, that they may become comparable to those of the surrounding islands and continents.

Principal associations.

From the many scattered data in the literature concerning the physiognomy of the vegetation (cf. Annex II), from my own acquaintance with the country during my visit in 1919—20 as botanist of the scientific Mamberamo Expedition and finally, from what I learnt from informations kindly given by several gentlemen¹⁾, many of whom are personally familiar with the country, I have tried to compile a picture of the principal associations, of their extent and their limits. These associations have roughly been drawn on the map accompanying the present paper (fig. 1). It is far from me to pretend that this map should present the associations with any degree of completeness but since a little bit is the next best to nothing, and practically nothing has been done as to mapping the vegetation of New Guinea, it may have some value as a starting point for supplementary studies.

As to the coast vegetation many details have come to my knowledge from literature, and personal informations added so many more that I could not incorporate all of them into a map of the present scale. The latter refers more especially to the Dutch part of the Island; for the Australian one I had to rely upon literature only. Next to some of the most important settlements I endeavoured to indicate whether the coast is mountainous (mostly along the N. coast and along the S.E. peninsula) or low, and if low, whether it is sandy (with *Pes caprae* and *Barringtonia*-associations and whether or not with *Casuarina equisetifolia*) or muddy (mangrove association). Small and often poor mangrove swamps occur in nearly every estuary, but extensive and fully developed

1) I have to thank the following gentlemen for their kind help: Dr C. BRAAK, H. GEURTJENS, N. HALIE, F. J. F. VAN HASSELT, Ir J. E. LOTH, Col. J. L. H. LUYMES, Prof. Dr G. L. SMIT SIBINGA, Dr J. J. SMITH, Dr C. G. G. J. VAN STEENIS and A. L. VINK.

swamps are found along the N. and NW. coast of the Gulf of Papua (Fly-river delta), from the Frederik Hendrik Island northward, along the S.E. and N. coasts of the Bomberai peninsula, the S. coast of the "Vogelkop", and the shores of the Straits of Sele. The flora of these coastal vegetations is, of course, not or hardly different from that of similar associations in this part of the world, since their elements are largely dispersed by ocean currents.

More inland by far the largest part of the island is covered by rain forest (hatched on the map). Considering the present state of exploration of the mountains I could not think of making an attempt to indicate separately the mountain forests, which, moreover, are usually not sharply distinguished from the true rain forests. I could not do more than indicate the open associations above the forest line and the small snow caps in the Dutch part, the freshwater swamps and the savannahs, and the places where two of the economically more important trees are growing abundantly: *Agathis alba* Foxw. (*gum copal*) and *Melaleuca Leucadendron* L. (*kaju putih* or *gėlam*). The last-named tree has a wide distribution from Australia and W. Polynesia as far as the Asiatic Continent and is cultivated in several places for its valuable oil. However, LANE-POOLE does not mention it as a useful tree in the Australian division.

While extensive plots of *Agathis alba* have been recorded from the Moluccas and the mountains of Dutch N. New Guinea as far east as Mt. Bonggo, the tree seems to be wanting or at any rate scarce in the Australian part. The record from the upper Sepik by the Dutch-German Boundary Expedition and that from the East Central Division (young specimen) by LANE-POOLE (Forest Resources, l. c., p. 167) are not fully trustworthy as the tree may be easily confounded with *Podocarpus Blumei* ENDL., especially in a young state. Moreover, the export figures for the Territories of Papua and New Guinea do not make any mention of the resin. Yet *Agathis* is represented in Australia, but it may be that the economic species (*A. alba* Foxw., and also *A. Labillardieri* WARB., the latter, for instance, from the Japen Island, Geelvinck bay) is restricted to the W. division.

Little need be said here of the freshwater swamps, which reach a pretty large extension in several spots, such as along the Fly- and Strickland rivers, in Frederik Hendrik Island, between the Central Range and the S.W. Coast, in the eastern half of the Bomberai Peninsula, around the Mac-Cluer-Gulf and Bintoeni Bay and in some inland basins

along rivers in the northern divisions (War Samsom [= Wasami], Idenburg river [Mamberamo; "Meervlakte"], Sepik and Ramu). In these parts all transitions occur between swampy forest to open water; sagu (*Metroxylon* spec.) and breadfruit tree (*Artocarpus communis* FORST. [= *incisa* L.]) are locally frequent here.

Though New Guinea is an entirely tropical island, situated but for a small part between the equator and the 10° S. parallel, there are some places where the rain forest has been replaced by associations that have often been called savannahs. It is, however, more than doubtful whether these associations are true savannahs in the sense of naturally open associations like those in N. Australia. The largest of these more or less open associations or "savannahs" are situated at the south coast, viz. between Prinses Marianne Strait and the Fly-River estuary and in the region of Port Moresby. Other places of a similar nature are found along the Goodenough Bay, near the Waria-River, the slopes S. and N. of the Finisterre Range and N. of the Bismarck Range etc., but these are either fully of anthropogenous nature or at least determined by steepness or limestone rocks.

The handbooks on ecology and plant-geography yield no or very scanty information as to the conditions of climate and soil that naturally correspond to those associations but it cannot be far from true to accept that the rainfall and particularly the distribution of the rainfall throughout the year are the main limiting factors here. It is generally accepted, that the rain forest for its full development requires a rainfall of at least 2000 (or under certain circumstances perhaps 1500) mm pro year with the condition that this amount is equally distributed over the year or nearly so. We further know, that as soon as the factor "water-supply" becomes a limiting factor the rain forest reacts by more domination of certain (tree)species of an often deciduous nature. The next phase is a deciduous monsoon-forest with only a small number of more or less dominating tree species and the next steps are the still more open savannah-forest, the "park landscape", the savannah, the steppe and the desert. As, in general, the duration of any external ecological factor is often of more importance for the determination of the vegetation and for the limitation of specific areas, than its momentary severity, it is, in the present case, more particularly the duration of the dry season (monsoon) that affects both of the features mentioned.

Unfortunately, in many parts of the Malay Archipelago the

original vegetation has been largely destroyed, and in many places the population has, moreover, the custom of annually burning the grasslands and "ladangs" (fields). Thus, it often cannot be definitely stated whether a grassland association in a region with a long dry season is natural or not.

I have therefore attempted to gather data as to the severity and duration of the dry season on one hand and the distribution of undoubtedly natural vegetations on the other. For that purpose I have accepted a method first applied, if I am well informed, by the Sugar Experiment Station at Pasoeroean, Java, which consists of mapping the areas where there are 0—5, 5—10, 10—20 or more than 20 rainy days in the driest 4 months of the year. It has been supposed that more than 20 rainy days eventually approaches the conditions under which full rain forest is possible. It needs no special mention that a low annual rainfall does not necessarily correspond to a long dry season. Thus Paloe (Mid-west Celebes at 1° S. lat.) has an annual rainfall of only 546 mm, distributed over 81.6 rainy days. Yet the driest four months of the year still have about 23 rainy days. This is probably the place with the lowest rainfall in the Malay Archipelago¹).

On looking at the accompanying map (fig. 2) the reader may see that the regions with the best developed dry season (less than 5 rainy days in the driest 4 months) comprises, first of all, by far the greater part of N. and N.W. Australia, and further islands or N. parts of islands belonging to the group known as the Lesser Sunda Islands, including a small coastal strip of East Java and Madoera. The place with an extreme dry season in this region is, beside the desert interior of Australia, the island of Solor, E. of Flores, which has a rainfall of 891 mm pro annum with 42 rainy days. Of these

none occur the driest 4 months

0.9	"	"	"	6	"
3.6	"	"	"	7	"
7.6	"	"	"	8	"

The part of Australia, shown on the map is less dry, as far as is known, having 2—4 rainy days in the driest 4 months (minimum for E. Java: 3.4).

1) Meteorological data from the publications of the „Koninkl. Magnetisch en Meteorologisch Observatorium" at Batavia (Verhandel. 18, 1924, and 23 and 24, 1931) and from informations, kindly given by Dr C. BRAAK.

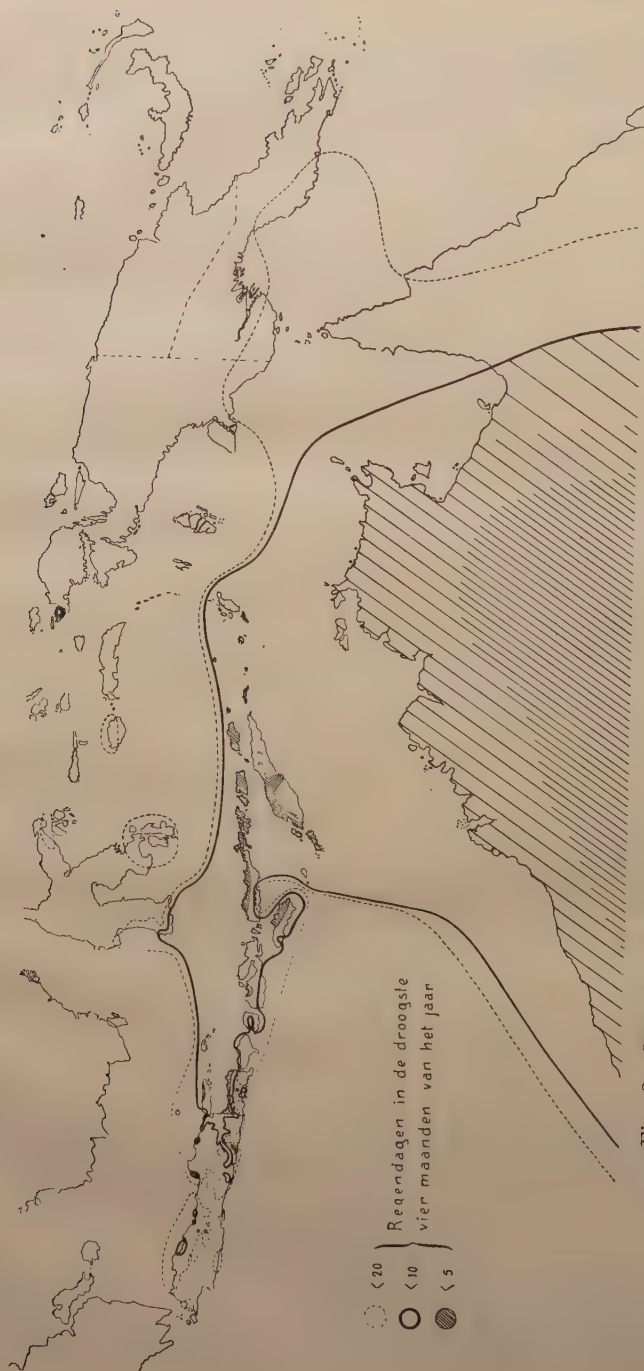


Fig. 2. Severity of the dry season in the Malay Archipelago and N. Australia, as indicated by the number of rainy days (0—5, 5—10, 10—20 or more than 20) in the driest four months of the year.

The 5—10 days line comprises the other parts of the Lesser Sunda Islands, except a small part of S.W. Flores, S.W. Soemba, S.W. Soembawa, W. Lombok and nearly the whole of Bali. The 10—20 days line includes large parts of East Java and smaller ones of W. Java (especially in the N.), further small coastal districts of S.W., S.E. and E. Celebes and N. Boeroe and finally the two larger dry areas in New Guinea, mentioned above.

The number of rainy days in the driest four months in Merauke and Port Moresby and their annual rainfall figures are:

	annual rainfall	rainy days i.t. dr. 4. m.
Merauke	1528 mm	16
Port Moresby	± 800 mm	17

Both regions perfectly agree as to this point with the western part of N. Queensland, the eastern being considerably wetter and possessing some true rain forests. This region, with 15—20 rainy days in the driest 4 months, is covered by savannah-forests as is apparent from the splendid pictures recently published by L. DIELS and E. PRITZEL (KARSTEN & WALTER, Vegetationsbilder, 24. Reihe, Heft 3, 1934, Taf. 17—18), whilst the more western parts (hatched on the map) possess a savannah or steppe vegetation.

I am inclined to conclude from these data that the Lesser Sunda Islands or at least their drier parts originally have a steppe-like vegetation, which has only little been altered by man. The more or less open associations in New Guinea, however, are of a purely anthropogenous nature as far as they are situated in the rain forest area; but those parts, lying within the 20 rainy days line originally must have had a Eucalyptus savannah-forest that has now partly been destroyed by the activities of the population. This conclusion is supported by their present flora, which consists of three distinctly distinguishable categories of elements, viz.:

1. purely Australian elements (trees such as *Eucalyptus*, *McLaleuca*, *Cycas*, some *Proteaceae*, *Acacia*, etc.).

2. trees that are common to other open associations whether natural or anthropogenous, mostly with wide distribution also in the western part of the Archipelago (*Alstonia scholaris* R.Br., *Albizia procera* BENTH., *Gossampinus heptaphylla* [HOUTT.] BAKH., *Garuga floribunda* DECNE., etc.).

3. herbs and other plants, which endure or survive the annual

burning, especially grasses (many species, among which the deep-rooting *alang-alang*, *Imperata cylindrica* BEAUV., var. *Koenigii* BENTH., or *Apluda*-species prevail), *Liliaceae* (with subterraneous bulbs), in wet places also *Drosera* (Australian!).

Floristics.

While the vegetation is mainly a function of the external factors and only in the second place of time, the last-named factor plays a prominent part regarding the flora. In general, one may say that the flora of a country consists of three categories of elements, that meanwhile are not sharply distinguishable:

1. relie-endemisms, being the progeny of unknown elements or of plants that have immigrated a long time ago;
2. neo-endemisms, being the offspring of plants which have immigrated in more recent times;
3. recent immigrants, which have not or not yet had the opportunity or the time to raise new species and for which the country thus forms a part of their area.

Time and immigration possibilities are therefore the main factors that determine a flora; ecological conditions, however important and selective they may be, are second in rank.

With appropriate observance of specific modes of dispersion and of relative differentiation, important conclusions may be drawn as to whether land connections with certain other lands, if any, are of old date or not. As regards New Guinea, conclusions of this nature may be of extreme importance since they may, in connection with data yielded by zoogeography and geology, procure indications as to which conception should be accepted for this part of the world: the old theory of the permanency of oceans and continents, or WEGENER's hypothesis of continental shift. In order to get a provisional idea of whether the New Guinea flora even when only partially investigated, may procure any data for conclusions of this kind, I have compiled some floristic data, that may follow here; these data have been laid down in six lists, viz.:

- I Relation of families, genera and species;
- II Endemism of genera and species;
- III Endemic genera;
- IV Some subendemic genera;
- V Groups with strong differentiation;
- VI Geographic relations.

TABLE I.

RELATION OF FAMILIES, GENERA AND SPECIES.

Data mostly taken from LAUTERBACH's Beiträge zur Flora von Papuasien; cases in which „Nova Guinea” has been consulted, have been indicated with an asterisk; if other publications have been used, they have been quoted. Only the families have been mentioned, that are in some way pertinent to our purpose.

Fam.	Number of		Fam.	Number of	
	Genera	Species		Genera	Species
Acanthaceae	21	55	Flagellariaceae	2	3
Amaryllidaceae	4	8	Gentianaceae	4	11
Anacardiaceae	12	47	Gesneraceae	12	180
Anonaceae	18	84	Gnetaceae	1	5
5 Apocynaceae	29	88	30 Guttiferae	9	67
Aquifoliaceae	1	5	Halorrhagaceae	2	9
(Journ. of Bot. 61, 1923, Suppl. 10)			*Icacinaceae	14	47
Araliaceae	13	85	Labiatae	10	19
Aristolochiaceae	1	15	Lauraceae	10	91
Balsaminaceae	1	8	35 Lecythidaceae	3	21
10 Bignoniaceae	4	26	Leguminosae	16	73
Burseraceae	5	30.	(Mimos. and Caesalp.)		
(Bull. J. bot. Btzg 1932)			Lentibulariaceae	1	4
Campanulaceae	5	6	Liliaceae	12	53
Capparidaceae	4	10	Linaceae	1	3
Clethraceae	1	1	40 Loganiaceae	7	44
(Kew Bull. 1899, 126)			Lythraceae	3	7
15 Commelinaceae	6	20	Melastomaceae	21	118
Compositae	48	69	Menispermaceae	7	56
Connaraceae	2	4	Monimiaceae	10	60
Cornaceae	2	3	45 Myricaceae	1	1
(Blumea, 1934)			*Myrtaceae	20	172
Cruciferae	2	5	Olcaceae	4	24
20 Cucurbitaceae	16	37	Oleaceae	4	24
Cunoniaceae	11	30	Opiliaceae	3	3
Dichapetalaceae	1	11	50 Orchidaceae	116	2546
Dilleniaceae	3	61	(Rogers 1932)		
Elaeocarpaceae	6	92	Palmae	33	125
25*Ericaceae	7	179	Pinaceae	3	7

<i>Fam.</i>	<i>Number of</i>		<i>Fam.</i>	<i>Number of</i>	
	<i>Genera</i>	<i>Species</i>		<i>Genera</i>	<i>Species</i>
Pittosporaceae	1	3	65 Stemonaceae	1	2
Pteridophyta	87	970	Sterculiaceae	11	31
55 Quercus (s.a.)	4	17	*Symplocaceae	1	30
Rhamnaceae	8	14	Taxaceae	3	11
Rubiaceae	47	378	Ternstroemiaceae	4	8
Rutaceae	18	82	70 Ulmaceae	4	12
Santalaceae	3	14	*Urticaceae	13	128
60 Sapindaceae	25	117	Violaceae	3	8
*Sapotaceae	11	47	Vitaceae	4	56
Saxifragaceae	7	30	74 Zingiberaceae	13	150
Scrophulariaceae	10	28			
Simarubaceae	5	5		834	6872

From these figures may be concluded that there are, in average:

92.7 species pro family — (80.8 } without Pteridophyta)
 11.35 genera pro family — (10.23 }
 8.16 species pro genus: (without Pteridophyta: 7.9; without
 Pteridophyta and Orchidaceae: 5.32)

TABLE II.

ENDEMISM OF GENERA AND SPECIES.

Mostly taken from LAUTERBACH's Beiträge zur Flora von Papuasien, sometimes amplified with data from „Nova Guinea" or other newer publications.

Area: Mainland of New Guinea with the Louisiades, the Bismarek Archipelago, the Admiralty Islands and the islands in the Geelvink bay, however, without the Aru and Kai Islands.

Subendemic means: with the bulk of the species in New Guinea and only one or very few outside the area.

	<i>Number of genera</i>		<i>Number of species</i>	
	<i>total</i>	<i>endemic</i> (subendemic)	<i>total</i>	<i>endemic</i>
Acanthaceae	21	4	55	32
Amaryllidaceae	4	—	8	2
Anacardiaceae	12	2	47	30
Anonaceae	18	4(1)		
5 Apocynaceae	29	6(2)	88	55
Aquifoliaceae	1	—	4	2

	Number of genera		Number of species	
	total	endemic (subendemic)	total	endemic
Araliaceae	13	1	85	78
Aristolochiaceae	1	—	15	10
Burseraceae	5	—(1)	30	22
10 Campanulaceae	5	1	6	4
Capparidaceae	4	—	10	2
Commelinaceae	6	—	20	5
Compositae	48	3	69	43
Connaraceae	2	—	4	3
15 Cornaceae	2	1	3	1
Cucurbitaceae	16	—	37	10
Dichapetalaceae	1	—	11	11
Elaeocarpaceae	6	2		
Ericaceae	7	1		
20 Flagellariaceae	2	—	3	—
Gentianaceae	4	—	11	9
Gesneraceae	12	4(2)	180	179
Gnetaceae	1	—	5	—
Guttiferae	9	4	67	62
25 Halorrhagaceae	2	—	9	6
Icacinaceae	14	3(1)		
Lauraceae	10	1		
Lecythidaceae	3	—	21	15
Leguminosae				
Mimosaceae	8	1(2)	35	22
Caesalpiniaceae	8	1	28	18
30 Liliaceae	12	—	53	29
Linaceae	1	—	3	3
Lythraceae	3	—	6	2
Melastomaceae	21	5	118	110
Menispermaceae	7	1		
35 Monimiaceae	10	3		
Myricaceae	1	—	1	—
Myrtaceae	20	2		
Olacaceae	3	—	3	1
Oleaceae	4	—	24	19
40 Opiliaceae	3	1	3	1

	Number of genera		Number of species	
	total	endemic (subendemic)	total	endemic
Orchidaceae (1934) ...	116	8(10)	2546	2534
Palmae	33	2(2)	125	115
Pittosporaceae	1	—	3	1
Pteridophyta			970	597
45 Quercus (s.a.)	4	—	17	12
Rhamnaceae	8	—	14	7
Rubiaceae	47	5		
Rubus	1	—	9	5
Rutaceae	18	4	82	68
50 Santalaceae	3	—	14	13
Sapindaceae	25	1	117	91
Sapotaceae	11	1	47	35
Saxifragaceae	7	2(1)	30	30
Scrophulariaceae	10	1	28	8
55 Stemonaceae	1	—	2	2
Symplocaceae	1	—	21	21
Taxaceae	3	—	11	4
Ulmaceae	4	—	12	7
Urticaceae	13	1	121	95
60 Violaceae	3	—	8	7
Vitaceae	4	—	56	34
Zingiberaceae	13	2(2)	150	140
Fam. uncertain (Ger-				
trudia, Marumia				
Warburgii)	2	2	2	2
	687	81(25)	5446	4614
	61 fam.		53 fam.	

Therefore the generic endemism is 11.6 (15.3¹⁾) %
the specific endemism: 84.7 %.

1) Subendemics calculated as one half.

TABLE III.

ENDEMIC GENERA ARE (those [16] names, marked with a W, have survived from WARBURG's list of 1891):

- Acanthaceae — *Ancylacanthus* LINDAU; *Calycacanthus* K. SCHUMANN (W);
Gymnophragma LINDAU; *Jadunia* LINDAU.
- Anacardiaceae — *Nothopegiopsis* LAUTERBACH; *Skoliostigma* LAUTERBACH.
- Anonaceae — *Oncodostigma* DIELS; *Oreomitra* DIELS; *Petalolo*phus
K. SCHUMANN; *Schefferomitra* DIELS.
- Apocynaceae — *Delphyodon* K. SCHUMANN; *Discalyxia* MARKGRAF; *Kentroschia* LAUTERBACH & SCHUMANN; *Lamechites* MARKGRAF; *Papuechites* MARKGRAF; *Pseudowillughbeia* MARKGRAF.
- Araceae — *Diandriella* ENGLER; *Holochlamys* ENGLER (W); *Xenophya*
SCHOTT (W).
- Araliaceae — *Palmervandenbroekia* GIBBS; *Peekeliopanax* HARMS (N.
Brit.).
- Aselepiadaceae — *Astelma* SCHLECHTER; *Spathidolepis* SCHLECHTER.
- Bignoniaceae — *Neosepicea* DIELS.
- Boraginaceae — *Crucicaryum* BRAND.
- Campanulaceae — *Phyllocharis* DIELS.
- Compositae — *Branchionostylum* MATTFELD; *Hecatactis* F. v. MUELLER;
Ischnea F. v. MUELLER (W).
- Cornaceae — *Mastixiodendron* MELCHIOR.
- Corsiaceae — *Corsia* BECCARI (W).
- Cruciferae — *Papuzilla* RIDLEY.
- Cunoniaceae — *Aistopetalum* SCHLECHTER; *Kaernbachia* SCHLECHTER;
Opocunonia SCHLECHTER; *Stollaea* SCHLECHTER.
- Cyperaceae — *Capitularia* SURINGAR.
- Elaeocarpaceae — *Anoniodes* SCHLECHTER; *Sericolea* SCHLECHTER.
- Epacridaceae — *Decatoca* F. v. MUELLER (W).
- Ericaceae — *Disiphon* SCHLECHTER.
- Euphorbiaceae — *Syndyophyllum* LAUTERBACH & SCHUMANN; *Tetraglochidion* SCHUMANN.
- Gesneraceae — *Cyrtandropsis* LAUTERBACH; *Euthamnis* SCHLECHTER;
Oxychlamys SCHLECHTER; *Sepikea* SCHLECHTER.
- Gramineae — *Buergersiochloa* PILGER.
- Guttiferae — *Cyclandra* LAUTERBACH; *Nouhuysia* LAUTERBACH; *Tetralthalmus* LAUTERBACH; *Tripetalum* SCHUMANN (W).
- Iacinaceae — *Leucocorema* RIDLEY; *Pentastira* RIDLEY; *Pocillaria*
RIDLEY.

Lauraceae — *Pseudocryptocarya* TESCHNER.

Leguminosae — *Schleinitzia* WARBURG (W); *Schizosecyphus* SCHUMANN (W).

Loganiaceae — *Dolianthus* C. H. WRIGHT.

Loranthaceae — *Dactyliophora* van TIEGHEM; *Distrianthes* DANSER; *Papuanthes* DANSER; *Rhizomonanthes* DANSER; *Sogerianthe* DANSER; *Tetradyas* DANSER.

Malvaceae — *Wilhelminia* HOCHREUTNER.

Melastomaceae — *Bammlera* LAUTERBACH & SCHUMANN; *Catanthera* F. v. MUELLER; *Phyllapophysis* MANSFELD; *Poikilogyne* GIBBS; *Serobicularia* MANSFELD.

Menispermaceae — *Macrocoeculus* BECCARI (W).

Monimiaceae — *Anthobembix* PERKINS; *Idenburgia* GIBBS; *Lauterbachia* PERKINS.

Moraceae — *Antiaropsis* SCHUMANN (W); *Dammaropsis* WARBURG (W).

Myrtaceae — *Octamyrtus* DIELS; *Xenodendron* LAUTERBACH & SCHUMANN.

Opiliaceae — *Gjellerupia* LAUTERBACH.

Orchidaceae — *Chitonanthera* SCHLECHTER; *Dryadorehis* SCHLECHTER; *Eurycentrum* SCHLECHTER; *Ischnocentrum* SCHLECHTER; *Papuaea* SCHLECHTER; *Porphyrodesme* SCHLECHTER; *Ridleyella* SCHLECHTER; *Sepalosiphon* SCHLECHTER.

Palmae — *Leptophoenix* BECCARI; *Sommieria* BECCARI (W).

Passifloraceae — *Hollrungia* SCHUMANN (W).

Proteaceae — *Finschia* WARBURG (W).

Rubiaceae — *Airosperma* LAUTERBACH & SCHUMANN; *Maschalodesme* LAUTERBACH & SCHUMANN; *Myrmedoma* BECCARI (W); *Siphonandrium* SCHUMANN; *Versteegia* VALETON.

Rutaceae — *Hormopetalum* LAUTERBACH; *Humbsteinia* LAUTERBACH; *Lamiofrutex* LAUTERBACH; *Terminthodia* RIDLEY.

Sapindaceae — *Mischocodon* RADLKOFER.

Sapotaceae — *Krausella* H. J. LAM.

Saxifragaceae — *Discogyne* SCHLECHTER; *Kania* SCHLECHTER.

Scrophulariaceae — *Detzneria* SCHLECHTER.

Urticaceae — *Gibbsia* RENDLE.

Zingiberaceae — *Eriolopha* RIDLEY; *Thylacophora* RIDLEY.

Fam. uncertain — *Gertrudia* SCHUMANN.

Total number: 110.

Doubtful:

?*Geitroa* BECCARI (W) cf. *WARBURG*, ENGL. BOT. JAHRB. 13, 1891, 231.

?*Marumia Warburgii* COGN., cf. ENGL. BOT. JAHRB. 60, 1926, 114.

Endemic Sections:

Dendrobium SCHWARTZ Sect. *Amblyanthus*.

.. *Herpetophytum*.

Glomera SCHLECHTER .. *Giulianettia*.

TABLE IV.

SOME SUBENDEMIC GENERA ARE:

Anonaceae — *Papualthia* DIELS (also in the Philippine Isl.).

Apocynaceae — *Excavatia* MARKGRAF (also 1 species in Kai): *Lepiniopsis* VALETON (also some species in the Phil., Mol., Polyn.).

Araliaceae — *Anomopanax* HARMS (also in the Phil.).

Burseraceae — *Haplolobus* H. J. LAM (10 species in N. G., 1 in Amboina, 1 in N. Borneo).

Cunoniaceae — *Betchea* SCHLECHTER (also in Australia).

Ericaceae — *Dimorphanthera* F. v. MUELLER (30 sp. in N. G., 1 in Amboina, 2 in the Phil., also in Fiji); *Paphia* SEEM. (also in Fiji).

Euphorbiaceae — *Endospermum* BENTHAM (*E. formicarum* BECCARI; also in Mol.).

Fungi — *Echinophallus* HENNINGS (*E. Lauterbachii* HENNINGS; also in Morotai).

Gesneraceae — *Boea* COMMERSON (some sp. in the W. part of the Archipelago); *Dichrotrichum* REINWARDT (30 sp. out of 33 [western]).

Himantandraceae — *Himantandra* F. v. MUELL. (also in Batjan and N.E. Australia).

Icacinaceae — *Rhiti(do)caryum* BECCARI (18 sp. N. G., 1 sp. Kai).

Leguminosae — *Archidendron* (*Hansemannia* incl.) F. v. MUELLER (also some sp. in Austr. and Polyn.); *Maniltoa* SCHEFFER (also sp. in Polyn.).

Menispermaceae — *Albertisia* BECCARI (monotypic, also in Boeroe).

Monimiaceae — *Levieria* BECCARI (also in Queensl. and Mol.); *Steganthera* PERKINS (18 spec. N. G., 1 sp. Celebes).

Moraceae — *Pseudotrophis* WARBURG (also 1 spec. in the Phil.).

Myrtaceae — *Xanthomyrtus* DIELS (also N. Caled., N.E. Austr. and N. Borneo).

- Ochnaceae — *Schuurmansia* BLUME (also in the Mol. and Borneo).
 Orchidaceae — *Aglossorhyncha* SCHLECHTER (also 1 sp. in Seran); *Calymmanthera* SCHLECHTER (also 1 sp. in Morotai); *Corysanthes* R. BROWN (*Corybas* SALISBURY) (also in Austr., some sp. in W. part of Mal. Archip.); *Epiblastus* SCHLECHTER (also in Samoa, Cel. and Mol.); *Hymenorehis* SCHLECHTER (also 1 spec. in Java); *Medioeclear* J. J. SMITH (also some sp. in Celeb.); *Microtatorehis* SCHLECHTER (also some sp. out of N. G.); *Pedilochilus* SCHLECHTER (also 1 sp. in Celeb.).
 Rubiaceae — *Amaracarpus* BLUME? (also in Western parts of Mal. Arch. and in the Phil.).
 Sapotaceae — *Burckella* PIERRE (also some sp. in Mol. and Polyn.).
 Saxifragaceae — *Carpodetus* FORSTER (also 1 sp. N. Zealand).
 Umbelliferae — *Didiscus* DE CANDOLLE (also in Austr. and N. Borneo).
 Verbenaceae — *Faradaya* F. v. MUELLER (1 spec. also in Queensl. and Borneo and 1 also in Seran).
 Zingiberaceae — *Riedelia* OLIVER? (also in Western parts of Mal. Arch.); *Tapeinochilus* MIQUEL (also in Mol. and Austr.).

Sections:

- Orchidaceae — *Bulbophyllum* THOUARS Sect. *Coelochilus*; Sect. *Dialeipanthé*; Sect. *Hyalosema*; Sect. *Macrouris*; Sect. *Pelma*; Sect. *Polyblepharon*.
Dendrobium SCHWARTZ Sect. *Calypetrochilus*; Sect. *Ceratolobium*; Sect. *Latouria*; Sect. *Oxyglossum*.
 Urticaceae — *Conocephalus* BLUME Sect. *Poikilospermum*.

TABLE V.

GROUPS WITH STRONG DIFFERENTIATION.

- Ericaceae — *Rhododendron* (\pm 80 spec.), *Vaccinium* (\pm 60 spec.).
 Myrtaceae — *Xanthomyrtus*; *Decaspermum*; *Syzygium*.
 Orchidaceae — abt. 2550 spec. in 116 genera.
 Pteridophyta — abt. 1000 spec. in 87 genera.
 Rubiaceae — abt. 380 spec. in 47 genera (especially: *Ophiorrhiza*, *Argostemma*, *Urophyllum*, *Randia*, *Hydnophytum*, *Psychotria*, *Timonius*).
 Araliaceae — *Boerlagiodendron*.
 Asclepiadaceae — *Hoya* ($>$ 50 spec.).
 Bignoniaceae — *Deplanchea*; *Pandorea*; *Tecomanthe*.
 Burseraceae — *Canarium*.

Coniferae — Libocedrus.

Corsiaceae — 1 genus in N. G. (Cordia), 1 in Chile.

Cunoniaceae — Gilbea; Pulla (also in Australia).

Dilleniaceae — Saurauia.

Elaeocarpaceae — Elaeocarpus.

Epacridaceae — Styphelia.

Gesneraceae — Aeschynanthus (= Trichosporum) (33 spec. out of ± 100); Cyrtandra (95 spec.).

Magnoliaceae — Drimys.

Melastomaceae — Medinilla (56 spec.).

Monimiaceae — Trimenia.

Myrtaceae — Backhousia (also in Australia).

Orchidaceae — Bulbophyllum (± 550 spec. in N. G.); Caladenia (74 spec. in N. G.); Dendrobium (± 575 spec. in N. G.); Liparis (> 100 spec. in N. G.); Microstylis (> 100 spec. in N. G.); Oberonia (> 100 spec. in N. G.); Phreatia (± 123 spec. in N. G.); Prasophyllum (72 spec. in N. G.); Pterostylis (64 spec. in N. G.); Taeniophyllum (> 100 sp. in N. G.); Thelymitra (49 sp. in N. G.).

Palmae — Drymophloeus.

Pandanaceae — Freycinetia; Pandanus.

Pteridophyta — Alsophila; Asplenium; Cyathea; Dryopteris, Polypodium; Selaginella; Trichomanes.

Sapotaceae — Planchonella.

Stereuliaceae — Sterculia.

Triuridaceae — Sciaphila.

Urticaceae — Cypholophus; Elatostema; Pilea.

Zingiberaceae — Alpinia.

Sections:

Orchidaceae — Dendrobium Sect. Diplocaulobium; Sect. Grostidium.

TABLE VI.

GEOGRAPHIC RELATIONS.

1. Asiatic and Malaysian Elements (those provided with an asterisk reach the eastern limit of their area in New Guinea).

Families:

*Ericaceae, abundant in New Guinea, practically wanting in Australia and Polynesia.

*Balsaminaceae

Gesneraceae

Lauraceae

*Myricaceae

Oleaceae

Ulmaceae, etc.

Genera:

Aquifoliaceae — Ilex.

Begoniaceae — *Begonia.

Bombacaceae — Gossampinus.

Borraginaceae — Cynoglossum (the New Guinea species, however, more related to Australian types?).

Burseraceae — Canarium; Garuga, *Santiria.

Campanulaceae — *Pentaphragma.

Combretaceae — Combretum; Terminalia.

Compositae — *Lactuca.

Dipterocarpaceae — *Anisoptera; Hopea; *Vatica.

Elaeocarpaceae — Elaeocarpus.

Ericaceae — Rhododendron; *Vaccinium.

Euphorbiaceae — Homalanthus.

Fagaceae — *Castanopsis; *Quercus s.a. (not in Australia, extant in Polynesia).

Gentianaceae — *Gentiana.

Gesneraceae — *Aeschynanthus (= Trichosporum); *Dichrotrichum.

Gonystylaceae — *Gonystylus.

Lauraceae — Litsea.

Lentibulariaceae — Utricularia.

Loranthaceae — *Macrosolen.

Monimiaceae — *Kibara.

Myrsinaceae — *Labisia.

Myrtaceae — Decaspermum; Syzygium.

Nepenthaceae — Nepenthes.

Orchidaceae — Bulbophyllum; Dendrobium; Habenaria; Peristylus; Phreatia; Spathoglottis.

Ranunculaceae — Ranunculus; *Thalictrum.

Rosaceae — *Potentilla; Rubus.

Rubiaceae — *Amaracarpus; Argostemma; Timonius.

Rutaceae — Acronychia; Atalantia; Evodia; Lunasia; Luvunga.

Santalaceae — Henslowia.

Saxifragaceae — *Astilbe; *Dichroa; Polyosma.
Sterculiaceae — Firmiana; *Pterocymbium; Sterculia.
Styracaceae — *Bruinsmia; *Styrax.
Symplocaceae — *Cordyloblaste; Symplocos.
Taxaceae — Podocarpus.
Ternstroemiaceae — *Adinandra; Eurya; Ternstroemia.
Urticaceae — Elatostema; Pilea.
Valerianaceae — *Triplostegia.
Verbenaceae — *Teysmanniodendron.
Violaceae — Viola.

2. **POLYNESIAN ELEMENTS** (an asterisk indicates that the western limit of the area is reached in New Guinea):

Araliaceae — Meryta (also New Caledonia); Plerandra; Tetraplasandra.
Apocynaceae — Clitandropsis.
Many Compositae.
Corynocarpaceae — *Corynocarpus.
Cunoniaceae — Spiraeanthemum.
Elaeocarpaceae — Antholoma (also New Caledonia).
Guttiferae — Penthaphalangium.
Myrtaceae — Mearnsia (also 1 species Philippines); *Xanthomyrtus (also New Caledonia).
Nepenthaceae — Nepenthes Vicillardii (also New Caledonia).
Pandanaceae — *Sararanga.
Santalaceae — Santalum.
Sapindaceae — Euphorianthus; Harpullia; Jagera; Tristiropsis.
Sapotaceae — Achradotypus.
Violaceae — *Agatea (also New Caledonia).

3. **ANTARCTIC ELEMENTS** (an asterisk indicates that the western limit of the area is reached in New Guinea; in general Southern Hemisphere, S. America inclusive):

*Corsiaceae (1 genus in New Guinea, 1 genus in S. America).
Cochlospermaceae — *Cochlospermum.
Compositae — Abrotanella.
Cruciferae — Papuzilla (endemic, but related with types of the Southern Hemisphere).
Cyperaceae — *Carpha.
Cupressaceae — Libocedrus (circumpacific; in the Malay Archipelago in Batjan only).

- Droseraceae — *Drosera* (many in Australia).
 Epacridaceae — *Styphelia* (as far West as Java).
 Halorrhagaceae — *Gunnera*; *Halorrhagis*.
 Iridaceae — **Libertia*.
 Liliaceae — **Astelia alpina*; some *Luzuriagoideae*.
 Magnoliaceae — *Drimys* (1 species in Borneo and Philipp.).
 Orchidaceae — *Glomera* (circumpacific).
 Oxalidaceae — *Oxalis*.
 Pinaceae — **Araucaria*.
 Pittosporaceae — *Pittosporum*.
 Polygonaceae — **Muehlenbeckia*.
 Rosaceae — **Acaena*.
 Sapotaceae — *Lucuma* (circumpacific).
 Saxifragaceae — **Carpodetus* (New Zealand).
 Scrophulariaceae — *Hebe* (N. Zealand, S. America).
 Thymelaeaceae — *Kelleria* (= *Drapetes*) 3 species in New Zealand, 2 in New Guinea, 1 in N. Borneo, 1 in S. Australia and Tasmania.

4. Australian Elements (an asterisk indicates that the northern limit of the area is reached in New Guinea):

- Proteaceae.
 Araliaceae — *Boerlagiodendron*; *Kissodendron*; *Mackinleya*.
 Casuarinaceae — *Casuarina*.
 Centrolepidaceae — *Centrolepsis*.
 Compositae — *Brachycome*; **Olearia*; **Tetramolopium*; *Vittadinia*.
 Cunoniaceae — **Betchea*; **Gilbea*; **Pullea*.
 Cyperaceae — *Cladium* (as far West as the Philipp.); *Gahnia*; *Schoenus* (as far West as the Philipp.).
 Dilleniaceae — **Hibbertia* (also in New Caledonia).
 Epacridaceae — *Styphelia* (240 species in Australia and S. America, some as far as the W. Archipelago).
 Eupomatiaceae — **Eupomatia*.
 Goodeniaceae — *Scaevola*.
 Gramineae — *Danthonia*; **Petrosia leporina*; *Monostachya*.
 Haemodoraceae — **Haemodorum*.
 Iridaceae — *Patersonia* (also N. Borneo).
 Liliaceae — *Arthropodium*; **Lomandra*; *Schelhammera* and other genera.
 Menispermaceae — *Carronia*.
 Monimiaceae — *Daphnandra*; **Palmeria*; **Piptocalyx*.

- Myrtaceae — *Baekhousia; Eucalyptus (as far West as Timor and Celebes); Melaleuca.
- Orchidaceae — Caladenia; Corysanthes (= Corybas); Microtis; *Pterostylus; Thelymitra (as far West as Java).
- Palmae — *Bacularia; *Hydriastele; *Kentia; *Linospadix.
- Phylodraceae — Helmholtzia.
- Pinaceae — Callitris s.s.
- Proteaceae — *Banksia; *Grevillea; *Stenocarpus (also in New Caledonia and N. Australia).
- Rubiaceae — Coprosma (some species as far West as the W. Archipelago).
- Santalaceae — Exocarpus (14 species in Australia; some as far West as the W. Archipelago and the Philipp.).
- Sapindaceae — Dodonaea.
- Saxifragaceae — Quintinia (1 species in the Philipp.).
- Scrophulariaceae — Euphrasia.
- Sterculiaceae — *Brachychiton.
- Stackhousiaceae — Stackhousia.
- Stylidiaceae — Stylidium.
- Taxaceae — Dacrydium (as far as the W. Archipelago); Phyllocladus (as far as N. Borneo, the Philipp. and Celebes).
- Umbelliferae — Didiscus (also N. Borneo); Oreomyrrhis.
- Orchidaceae — Dendrobium Sect. Rhizobium.

From these statements we may notice the following points:

1. The *strong differentiation* appearing from the high figure for species pro genus and pro family and genera pro family (Table I). If we compare them with the corresponding figures for Borneo ¹⁾, an island of a quite diametrically different geological history but of almost the same area, we get the following statement (*Spermatophytes* only):

	New Guinea	Borneo
area in km ²	± 800.000	± 750.000
nr. of spec. pro fam.	80.80	32.00
„ „ gen. „ „	10.23	7.32
„ „ spec. „ genus	7.90	4.34

1) E. D. MERRILL, Enum. Born. Pl. — Journ. Str. Br., Roy. As. Soc., Spec. Numb. Sept. 1921.

This means that the development of what we have to consider as the younger elements (species) has been much stronger in New Guinea than in Borneo (proportion concerning species pro family $80.80:32.00=2.52$; concerning species pro genus $7.90:4.34=1.82$). The difference on the development of older units (genera) is less (proportion concerning genera pro family $10.23:7.32=1.4$), though it is obvious that also the genera have taken part in the differentiation. The flora of Borneo, that has to be considered as a part of the Asiatic Continent (cf. LAM, l.c., 1929 and 1930) thus appears to be less differentiated than that of New Guinea and the difference is greatest in the younger ($2.52:1$), smallest concerning the older units ($1.4:1$). It must therefore be concluded that the flora of Borneo is older than that of New Guinea, since we may suppose that the differentiation affects the youngest units only, while the older ones get their differentiation indirectly, viz. by natural elimination of individuals, forms, etc. between the concentration points of individuals that form the species. Thus the discontinuity between groups of individuals become more distinct as these groups grow older and a flora which for a great deal consists of young and strongly differentiated units with close mutual relations must therefore, as a whole, be younger than a flora with less differentiation and more evident discontinuity between the groups.

2. This point leads us to the *endemism* factor. It is generally believed that as the discontinuity between endemic units and their nearest relations is greater, the flora as a whole is older. Now the New Guinea flora (Tables II, III, IV) possesses not a single endemic family, while Australia, with which the island forms a geological unit, has several endemic families (*Cephalotaceae*, *Tremandraceae*, *Brunoniaceae*, etc.) and many subendemic ones. The number of younger endemic elements, however, is great. Compared with Borneo these figures are:

	New Guinea	Borneo
Generic endemism	11.6 %	4.1 %
Specific endemism	84.7 %	49.0 %

Moreover it appeared to me that of the New Guinea endemic genera none (as far as I know) is very much different from its relations and many are pretty closely allied to their nearest relations. Though there are some 110 genera known at present to be endemic in New Guinea, this endemism must therefore be relatively young. This conclusion is supported by the high specific endemism figure. Conclusions

concerning this have, however, to be treated with the utmost care and criticism, because the endemism figure is also dependent upon land connections and emigration possibilities. This is also the reason why the endemisms of New Guinea and Borneo cannot be compared like the relations of families, genera and species, since the land connections may have been (and possibly actually have been) entirely different both in time and in age. At any rate, we may state that there are no old relic-endemics (as far as I know) and that, therefore, the endemic elements must have originated in relatively recent times (neo-endemics). It is my impression that the process of differentiation is still going on vigorously after the island has been severed from surrounding landmasses. Apparently New Guinea has, in a relatively recent time, become a centre of dispersion as has been remarked before by several authors (COPELAND, SCHLECHTER, etc.). Yet some units have got the opportunity of spreading and settling in regions outside the island. I have enumerated some of these in Table IV. As far as relations to Australia are concerned, it may in some cases be difficult to discriminate whether a genus has originated in New Guinea or in the Australian Continent, but in most other cases it may be readily accepted that New Guinea has been the birthplace, also of many species or genera that are now found in New Guinea and in Australia only. Such units could be called 'secondarily Australian'.

It hardly needs to be mentioned that the endemism figure increases at higher altitudes. This is a phenomenon of general validity, probably due to the presence of more pronounced barriers and the strong variation of external factors in relatively small areas. As in many other mountain ranges some plant families have separate species on almost every peak (*Orchidaceae*, *Ericaceae*, *Gesneraceae*, etc.) and it cannot be explained by a general rule why other mountain species have so wide a distribution (cf. GIBBS, l.c.). Thus the endemism figure for the flora of the "Sattelberg"¹⁾ was between

100— 700 m: 41 %

700—1000 m: 70 %

On examining the *Compositae*, it is striking that of the 25 lowland species there is only one endemic, while there are 42 among the 44 mountain species. In general the endemism of Papuan subalpine species must be something like 90 %; in Java it is only 30 %¹⁾.

1) TH. SCHMUCKER, Beiträge z. Kenntn. der Hochgebirgsflora Javas und zur Theorie der Pflanzenausbreitung. — Beih. Bot. Centralbl. XLIII, 1927, 34—68, 5 figs.

3. The third point concerns the *relations of neo-endemics and recent immigrants*. It has, since the times of WALLACE's book (*The Malay Archipelago*, etc. 1864), often been said that the Australian element in the Papuan flora should be very considerable; in more recent times, however, a closer investigation has distinctly shown that the Australian element is relatively poor; apparently the former conception has been induced by the phytogeographical interest raised by Australian types in an Asiatic flora. It now is obvious that the Papuan flora is mainly Asiatic in character, particularly in the lower regions.

WARBURG (1891, p. 237) mentioned a collection from the lower regions of the former German Division containing 547 non-endemic species. Of these 273 (50 %) were in common with the Malay Archipelago only, 9 with Polynesia only and 6 in Australia only. These 288 species therefore had their area boundary in New Guinea.

Of the 970 species of *Pteridophytes* known to occur in New Guinea in 1920¹⁾ the island had in common with

the Malay Archipelago	249	} 428
„ Philippines	179	
Polynesia	165	
Australia	78	

Of the 25 Sapindaceous genera, known in 1920²⁾, 9 belong to the Asiatic, 12 to the Polynesian and 4 to the Australian group, while of the 26 non-endemic species 24 were Asiatic and 2 cosmopolitic.

It seems that, as far as Western elements are concerned, the relations are particularly strong with the Moluccas (*Excavatia*, *Haplolobus*, *Dimorphanthera*, *Endospermum formicarum*, *Echinophallus Lauterbachii*, *Himantandra*, *Rhitidocaryum*, *Levieria*, *Schuurmansia*, *Aglossorhyncha*, *Calymmanthera*, *Tapeinochilus*, etc.), the Philippines (cf. MERRILL 1926), as is, for instance, evidenced by such genera as *Alyxia*, *Rauwolfia*, *Osbornia*, *Macropsychanthus*, *Papualthia*, *Parsonsia*, *Andruris*, *Anomopanax*, *Dimorphanthera*, *Pseudotrophis* and *Epiblastus* and also with Celebes (*Mediocalcar*, *Steganthera*, *Pedilochilus*, etc.) and Borneo, particularly Mt. Kinabalu (*Haplolobus*, *Schuurmansia*, *Faradaya*, *Euphrasia*, *Didiscus*, *Drimys*, *Xanthomyrtus*, etc.).

Generally speaking, the Asiatic element decreases in percentage in

1) Engl. Bot. Jahrb. 56, p. 31.

2) Engl. Bot. Jahrb. 56, p. 251.

the mountains. But even there it is prevailing. A small collection of plants made by me above the forest line on Doorman peak (3580 m) consisted of 155 species (among which representatives of 10 endemic genera). Of these 60 % was of Asiatic origin (19 % boreal, 37 % with relations in S.E. Asia and 4 % belonging to endemic genera with Asiatic relations) and 40 % non-Asiatic (16 % Australian, 9 % Antarctic-Polynesian and 15 % belonging to endemic genera with Australian relations). If we compare these figures with those of the mountain flora of Java (Th. SCHMUCKER, l.c.) we must state that at least 88 % of the last-named flora is of Asiatic origin and about 3.5 % non-Asiatic (the rest comprises anthropochores and similar elements).

These few examples, that can easily be amplified, may suffice to show that the Papuan flora is mainly Asiatic and that Polynesian elements are second in rank.

Resuming we may state that:

- a. there are no relic-endemisms known at present;
- b. there is a strong neo-endemism, especially at higher altitudes;
- c. Asiatic floral elements prevail, even in the mountains, Polynesian ones come next and Australian-Antarctic ones apparently last, Australian ones being best represented in the mountains (and in the savannahs);
- d. western relations are particularly strong with the Moluccas, the Philippines and Celebes (beside relations with high peaks).

The questions which now arise are:

Do these facts agree with one of the above mentioned theories concerning the geological history of this part of the world, and if so, with which? Can they be explained by one of them, and if so by which?

Let me give a concise review of both.

The theory of the permanency of continents and oceans considers the Malay Archipelago as the remainders of an ancient continental mass that once connected what is now the Continent of Asia (Sunda-shelf) and that of Australia (with New Guinea; Sahul-shelf).

Should New Guinea be a part of such an intercontinental land connection that must have been severed a long time ago, then we must find some trace of it in the flora, viz. in old Asiatic types or relic-endemic units. As long as these are not known we have to deny the possibility that New Guinea has formed a part of a former land connection between Asia and Australia, and we have to see whether the other conception may explain the facts enumerated.

I think that, provisionally, there is no reason why we should not

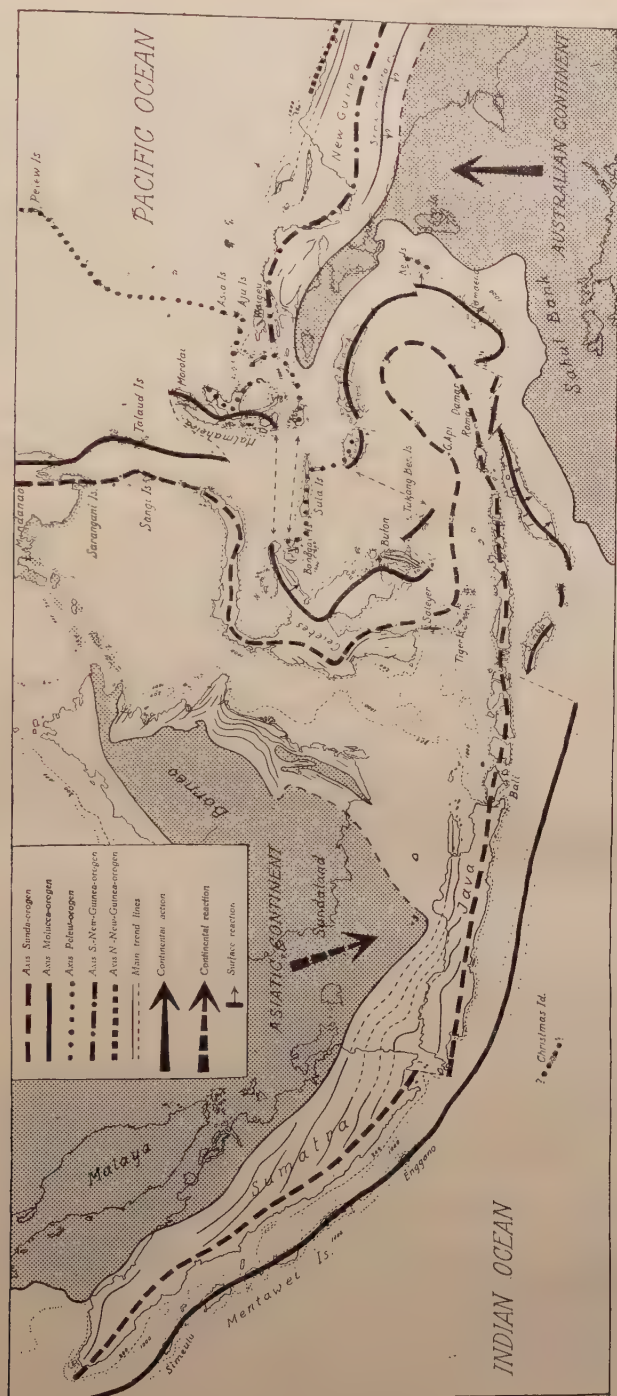
accept WEGENER's views as applying to this part of the world.

According to this remarkable hypothesis, that is of the utmost importance for biogeography, the Australian shelf has disjoined itself from the Antarctic Continent in the Eocene. Drifting northward or north-westward (with New Guinea in front), the shelf came into contact with the most south-eastern parts of Asia, where two or possibly three island arches were lying off the coast of the continent. SMIT SIBINGA has newly made extensive studies of the geological conditions of these arches (orogens) and, accepting WEGENER's hypothesis, has investigated the epeirophoresis (continental shifting) and orogenesis in these parts since the first contact was established. I avail myself of this opportunity to tender him my best thanks for his kind interest in my work and for the valuable informations concerning the subject he was kind enough to provide me with at my request. It is the opinion of Prof. SMIT SIBINGA that of the three arches mentioned the outer one (Pelew-orogen) was almost entirely destroyed (cf. fig. 3); it is only to be traced now by its northernmost remainders. The second one (the Molucca-orogen) was heavily disturbed and partly broken into sections, but can still be followed; the inner arch, finally (the Sunda orogen), has only partly endured a strong deformation but is still intact for long stretches. SMIT SIBINGA further suggests, that the epeirophoresis has not been a process of constant pressure, but that periods of a powerful shifting, during which mountain ranges were raised — the Central Range has originated in this way, and the smaller ranges north of it equally — alternated with periods of relative rest, during which erosive forces undid, partially or wholly, what orogenesis had created. It goes without saying that biogeographical contact by means of land connections can only be expected to be established a long time after the geological contact commenced. Now there have been, in SMIT SIBINGA's opinion, three main epeirophoreses:

1. one rather powerful push in the Old Tertiary that can be traced in the Molucca orogen;

2. a second, very powerful one in the Upper Miocene (Central Range of New Guinea raised?), which can equally be traced in the Molucca orogen and which possibly raised surface contacts (land connections) and

3. a weak shifting of Plio-plistocene age (Northern Ranges of New Guinea raised?) that affected both the Molucca orogen and the Sunda orogen.



Accepting the thesis that the second epeirophoresis was the first with biogeographical consequences and also the most important one, we must state that the biographical contact is relatively young. But we must equally realize that New Guinea, being a part of the Australian continent, must originally have possessed a flora, entirely different from that of Asia and not only different but very much poorer. According to WEGENER's views, the Australian shelf has, ever since the first crustal movements in the Carbon period, been situated quite near the South pole. Only in relatively recent times a part of this shelf has arrived in the tropics¹⁾ and if this whole conception is true, we cannot but expect that under such conditions, this part has, after the land connections had been established, been overrun with tropical species.

It is equally obvious that the largest part of these species were hailing from the regions that were richest as to their flora and with which the contact was probably most intense, viz. Asia (the Malay Archipelago); but it is, according to this conception, also understandable that Polynesian elements though hailing from relatively small and scattered islands, are second in rank, and that of the purely Australian elements only a relatively small number has succeeded in adaptation to such different conditions. And it is quite in accordance with the present conception that Australian types have more particularly survived or settled in those areas whose conditions are the least deviating from what may be supposed to be former and what are present Australian conditions, viz. in the cooler mountains and in the drier savannahs.

I cannot help, finally, to apologize for the above, fairly bold and perhaps somewhat premature, conception. It has only been my aim to gather some provisional data; to stipulate one of the most interesting biogeographical problems extant; to show a possibility of solving it; and to indicate the many points that are still unknown. It is my intention to gather, in the years to come, more detailed information, without, I hope, being prejudiced and I will feel very much satisfied, if I have raised the interest of biogeographers, and stimulated them to contribute data or opinions²⁾ in order that we may, in collaboration, mutually and with the geologists, finally come to some solution.

1) The Malay Archipelago has, probably, never seriously been affected by polar movements and has always had a tropical climate.

2) As the Editor of „Blumea” I will be glad to offer hospitality to such papers that might deal with the above subject.

H. J. L.

Annex I.**More important collectors in New Guinea.****1. *Vogelkop* (cf. GIBBS, 1917).**

- 1824 — P. LESSON (Dorei; on board "Coquille").
1871 — J. E. TEYSMANN (Dorei, etc.).
1872 — L. M. D'ALBERTIS (Hatam, 1500 m).
1872, 1875 — O. BECCARI (Hatam, 1500—2000 m).
1889 — O. WARBURG (Manoekwari).
1891 — D. BURKE (Hatam, orchids).
1912 — K. GJELLERUP (Angi-lakes); much material lost).
1912 — R. F. JANOWSKY (Manoekwari).
1913 — L. S. GIBBS (Angi-lakes, etc.).
1928 — E. MAYR (Arfak, Wandammen).

2. *Dutch North New Guinea*.

- 1903 — A. WICHMANN (nat. ass.: ATASRIP; W. coast Geelvink bay, Cycloop Range, Hollandia, Sentani-lake).
1910 — M. MOSZKOWSKY (Mamberamo and Van Daalen Riv.; much material lost).
1910—1911 — K. GJELLERUP (Gauttier Mts., Boundary; partly lost).
1912 — R. F. JANOWSKY (N. coast).
1913 — KORNASSI (nat. coll.; N. coast).
1913—1915 — A. C. TH. THOMSEN (Mamberamo).
1914 — W. K. H. FEUILLETAU DE BRUYN (nat. ass. AJOEBO; Schouten Is., Mamberamo, Idenburg Riv.).
1914 — L. A. C. M. DOORMAN (Doorman peak).
1919—1920 — H. J. LAM (Mamberamo, Doorman peak, Central Range).
1926 — W. M. DOCTERS VAN LEEUWEN (Mamberamo, Central Range).
1928 — E. MAYR (Cycloop Mts.).
1931 — G. STEIN (Weyland Mts., Japen, Waigeoe).

3. *Dutch South New Guinea*.

- 1828 — A. ZIPPEL (Etna bay, Triton bay).
1901 — JAHERI (nat. coll.).
1904—1905 — J. W. R. KOCH (Merauke, Etna bay, Digoel Riv.).
1907 — G. M. VERSTEEG (S. of Wilhelmina peak).
1907—1908 — B. BRANDERHORST (Merauke, Fred. Hendr. Isl., Eilanden Riv., Digoel Riv., Otakwa Riv., Noord Riv.).
1908—1912 — J. M. DUMAS (Merauke c.a., Digoel Riv. etc.).

1909 — L. S. A. M. VON RÖMER (S. of Wilhelmina peak).

1909 — J. H. J. LE COCQ D'ARMANDVILLE (Kents Mts.).

1911 — C. BODEN KLOSS (S. of Carstensz peak).

1911 — A. C. DE COCK (Eilanden Riv.).

1912—1913 — A. A. PULLE (S. of Wilhelmina peak).

4. *Territory of New Guinea* (cf. SCHUMANN & LAUTERBACH, 1905).

1875 — C. NAUMANN.

1886—1888 — M. HOLLRUNG.

1887—1889 — L. KÄRNBACH.

1888 — F. C. HELLWIG.

1889 — O. WARBURG.

1889—1891 — C. A. F. WEINLAND.

1890—1891, 1896, 1899—1900 — C. LAUTERBACH.

1899 — E. O. A. NYMAN.

1901—1902, 1907—1909 — R. SCHLECHTER.

1910 — PEEKEL (N. Brit.).

1910 — SCHULTZE.

1912—1914 — C. LEDERMANN.

1912, 1916 — CHR. KEYSSER.

1922—1923 — C. E. LANE-POOLE.

1929 — E. MAYR (Saruwaged= Salawaket).

1933 — L. J. BRASS.

5. *Territory of Papua* (cf. WHITE, 1922).

1875 — Sir WM. MACLEAY (Isl. Torres Str., Mainland)

1875 — Rev. S. MACFARLANE (Baxter and Fly River).

1875 — L. M. D'ALBERTIS (Yule Isl. and Mekeo).

1875—1877 — L. M. D'ALBERTIS (Fly River).

1876—1877 — A. GOLDIE.

1884—1887 — Rev. JAS. CHALMERS.

1885 — H. O. FORBES (Sogeri).

1886 — W. BAUERLEN.

1888—1898 — Sir WILLIAM MACGREGOR (Fly Riv., Astrolabe Range,
Mt. Victoria).

1889 — Sir WILLIAM MACGREGOR (Owen Stanley Range).

1897 — Sir WILLIAM MACGREGOR (Mt. Scratchley).

± 1896 — GIULIANETTI and A. C. ENGLISH (Mt. Scratchley, Wharton
Range, Vanaipa Valley).

1898 — F. M. BAILEY.

- 1899—1903 — Sir G. R. LE HUNTE.
 1904—1907 — F. R. BARTON.
 ± 1907—1910 — Rev. C. KING (Ambasi).
 1908 — Mrs. H. T. SCHLENCKER (Boku).
 1918 — C. T. WHITE (Dilava-Mafula, Yule Isl. distr.).
 1922—1923 — C. E. LANE-POOLE.
 ± 1925 — Rev. L. TURNER (Rigo distr.).
 1925—1926, 1933 — L. J. BRASS.
 1929 — E. MAYR.

Annex II.

More important literature on the Botany of New Guinea.¹⁾

General information:

Annales du Jardin Botanique de Buitenzorg.
 Bibliotheca Botanica.
 Bulletin du Jardin Botanique de Buitenzorg.
 Bulletin Dépt. Agric. Ind. Néerland.
 Journal of Botany.

*Mededeelingen van het Encyclopaedisch Bureau: XXI. Schouten en Paidaido-Eilanden. (W. K. H. Feuilletau de Bruyn) 1920.

*Mededeelingen Afd. Bestuurszaken van de Buitengewesten, Serie A No. 2. Het Gouvernement der Molukken. (A. J. BEVERSLUIS en A. H. G. GIEBEN) 1929.

Verslag Militaire Expl. Ned. Nieuw-Guinea 1907—1915. — Welt. 1920.

Z. W. Nieuw-Guinea expeditie van 1904—1905. — E. J. Brill, Leiden 1908.

Verslag der commissie (Uittreksel uit het —) ter voorbereiding van de aanwijzing eener natuurlijke grens tusschen het Nederlandsche en het Duitsche gebied op Nieuw-Guinea (1910—1911).

C. Lauterbach e. o., Beiträge zur Flora von Papuasien. — Engl. Bot. Jahrb., 1912 - hodie.

	Vol.	Year	Page	Beitr. Part	Nr.
Acanthaceae	50	1913	164	II	18
„	55	1918	135	VI	54
Alangiaceae	60	1926	162	XIII	109
Amaryllidaceae	50	1913	301	III	21
Anacardiaceae	56	1920	345	VII	66
„	59	1925	535	XII	99
Anonaceae	49	1912	113	I	8
„	52	1915	177	IV	35
Apocynaceae	61	1927	164	XIV	117

1) An asterisk denotes that special mention has been made of the literature concerning the subject.

	Vol.	Year	Page	Beitr. Part.	Nr.
Aquifoliaceae	59	1925	80	XI	93
Araceae	49	1912	90	I	5
"	54	1917	74	V	39
Araliaceae	56	1920	374	VII	67
Aristolochiaceae	52	1915	104	IV	29
"	58	1923	488	X	89
Asclepiadaceae	50	1913	81	II	17
Balanophoraceae	50	1913	68	II	14
Balsaminaceae	55	1918	114	VI	51
Begoniaceae	50	1913	335	III	25
Bignoniaceae	57	1922	496	VIII	78
Burmanniaceae	49	1912	100	I	6
"	55	1918	202	VI	57
Burseraceae	56	1920	317	VII	64
Caesalpiniaceae	55	1918	19	VI	49
Campanulaceae	55	1918	121	VI	52
Capparidaceae	52	1915	108	IV	30
"	61	1927	30	XIV	115
Caryophyllaceae	61	1927	164	XIV	117
Cinnamomum	58	1923	492	X	90
Combretaceae	57	1922	427	VIII	73
Commelinaceae	50	1913	54	II	12
Connaraceae	58	1923	178	IX	83
Compositae	62	1929	386	XVI	124
Convolvulaceae	59	1925	84	XI	94
Cornaceae	60	1926	167	XIII	110
Corsiaceae	49	1912	109	I	7
Cruciferae	55	1918	265	VI	60
Cucurbitaceae	60	1926	150	XIII	108
Cunoniaceae	52	1915	138	IV	33
Cyperaceae	59	1925	41	XI	91
Dichapetalaceae	49	1912	168	I	9
"	62	1929	341	XVI	119
Dilleniaceae	57	1922	436	VIII	75
Dipterocarpaceae	57	1922	460	VIII	76
Elaeocarpaceae	54	1917	92	V	40
Ericaceae	55	1918	137	VI	55
Erythroxylaceae	58	1923	249	X	83
Flacourtiaceae	55	1918	273	VI	61
Flagellariaceae	50	1913	288	III	19
"	59	1925	544	XII	103
Fungi	54	1917	246	V	47
"	57	1922	321	VIII	68
Gentianaceae	61	1927	28	XIV	114
Gesneraceae	58	1923	255	X	85

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Gnetaceae	60	1926	144	XIII	107
Gramineae	52	1915	167	IV	34
Guttiferae	58	1923	1	IX	80
"	61	1927	30	XIV	115
Halorrhagaceae	61	1927	26	XIV	113
Himantandra	55	1918	126	VI	53
Hydrocharitaceae	49	1912	68	I	3
Icacinaceae	58	1923	155	IX	82
Juglandaceae	50	1913	66	II	13
Labiatae	62	1929	376	XVI	122
Lauraceae (cf. also sub Cinnamomum)	58	1923	380	X	86
Lichenes	58	1923	250	X	84
Lecythidaceae	57	1922	341	VIII	70
Lentibulariaceae	62	1929	382	XVI	123
Liliaceae	59	1925	547	XII	104
"	50	1913	290	III	20
Linaceae	52	1915	115	IV	31
Loganiaceae	54	1917	156	V	41
Loranthaceae	57	1922	464	VIII	77
Lycopodiaceae	54	1917	226	V	45
Lythraceae	61	1927	23	XIV	112
Magnoliaceae	50	1913	70	II	15
"	54	1917	239	V	46
Melastomaceae	60	1926	105	XIII	106
Menispermaceae	52	1915	187	IV	36
Mimosaceae	55	1918	19	VI	49
Monimiaceae	52	1915	191	IV	37
"	55	1918	195	VI	56
"	58	1923	244	X	82
Musaceae	50	1913	306	III	22
Musci	55	1918	19	VI	48
Myricaceae	59	1925	540	XII	101
Myrtaceae	57	1922	356	VIII	72
Nyctaginaceae	52	1915	101	IV	28
Oleaceae	61	1927	1	XIV	111
Olacaceae	58	1923	155	IX	82
Opiliaceae	58	1923	155	IX	82
Orchidaceae	58	1923	50	IX	81
"	66	1934	161	XX	126
Palmae	52	1915	19	IV	26
"	28	1923	441	X	87
Pandanaceae	49	1912	60	I	2
Pinaceae	50	1913	46	II	11
Piperaceae	55	1918	204	VI	58

	Vol.	Year	Page	Beitr. Part.	Nr.
Piperaceae	57	1922	354	VIII	71
Pittosporaceae	62	1929	338	XVI	118
Proteaceae	50	1913	328	III	24
"	54	1917	198	V	42
Pteridophyta	49	1912	1	I	1
"	56	1920	31	VII	62
Quercus s. a.	59	1925	41	XI	92
"	59	1925	538	XII	100
Rhamnaceae	57	1922	326	VIII	69
"	59	1925	535	XII	99
Rubiaceae I Cinchoneae	60	1926	1	XIII	105
Rubiaceae II Coffeoidae	61	1927	32	XIV	116
Rubus	54	1917	69	V	38
Rutaceae	55	1918	221	VI	59
"	59	1925	535	XII	99
"	61	1927	30	XIV	115
Santalaceae	59	1925	118	XI	97
Sapindaceae	50	1913	73	II	16
"	56	1920	251	VII	63
Sapotaceae	58	1923	463	X	88
Saxifragaceae	52	1915	118	IV	32
Scrophulariaceae	59	1925	99	XI	96
Selaginella	50	1913	1	II	10
Simarubaceae	56	1920	341	VII	65
Solanum	55	1918	58	VI	50
Stemonaceae	59	1925	541	XII	102
Sterculiaceae	62	1929	347	XVI	120
Symplocaceae	54	1917	212	V	44
Taxaceae	54	1917	207	V	43
Theaceae	57	1922	431	VIII	74
Triuridaceae	49	1912	70	I	4
Ulmaceae	50	1913	308	III	23
Urticaceae	57	1922	501	VIII	79
Verbenaceae	59	1925	87	XI	95
Violaceae	62	1929	368	XVI	121
Vitaceae	59	1925	505	XII	98
Zingiberaceae	52	1915	40	IV	27

Nova Guinea.

Résultats des Expéditions scientifiques à la Nouvelle Guinée,

Vol. VIII (1909—1914), XII (1913—1917), XIV (1924—1932).

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Acanthaceae	VIII	2	1910	333
Aizoaceae	"	"	"	335

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Algae	"	"	"	253
Amarantaceae	"	2	1910	351
"	"	4	1912	627
Amaryllidaceae	"	5	1913	899
Anacardiaceae	"	2	1910	297
"	"	4	1912	829
"	XIV	1	1924	97
Anonaceae	VIII	3	1911	427
"	"	4	1912	871
Apocynaceae	XIV	2	1927	278
Araceae	VIII	"	1910	247
"	"	4	1912	805
"	XIV	2	1927	210
Araliaceae	VIII	"	1910	271
Balanophoraceae	"	4	1912	777
"	"	5	1913	919
Bignoniaceae	XIV	2	1927	293
Borraginaceae	VIII	"	1910	399
"	"	4	1912	683
Burmanniaceae	"	1	1909	193
"	"	4	1912	895
Burseraceae	"	2	1910	295
"	"	4	1912	827
"	XIV	1	1924	135
Campanulaceae	VIII	2	1910	407
"	"	4	1912	691
Casuarinaceae	"	2	1910	347
"	"	4	1912	621
Celastraceae	"	2	1910	279
Chenopodiaceae	"	"	"	349
Chloranthaceae	"	4	1912	623
Clethraceae	XII	2	1914	169
Combretaceae	VIII	"	1910	317
"	"	4	1912	847
"	XIV	2	1927	196
Commelinaceae	VIII	5	1913	905
Corsiaceae	"	1	1909	197
"	"	4	1912	893
"	XII	2	1914	171
Cruciferae	VIII	"	1910	363
"	"	4	1912	641
Cucurbitaceae	"	2	1910	405
"	"	4	1912	689
Cunoniaceae	"	"	"	645
"	XII	5	1917	491

	Vol.	Part	Year	Page
Cunoniaceae	XIV	1	1924	150
Cycadaceae	VIII	2	1910	343
Cyperaceae	"	4	1912	695
Dichapetalaceae	XIV	"	1932	533
Dilleniaceae	VIII	2	1910	307
"	"	4	1912	835
"	XIV	1	1924	81
Dipterocarpaceae	"	2	1927	222
Ebenaceae	VIII	1	1909	199
Elaeocarpaceae	"	"	"	173
"	"	4	1912	661
"	XIV	1	1924	151
"	"	2	1927	304
Epacridaceae	VIII	4	1912	797
"	XII	5	1917	539
Equisetaceae	VIII	4	1912	619
Ericaceae	"	1	1919	183
"	"	4	1912	875
"	XII	2	1914	129
"	"	5	1917	495
Euphorbiaceae	VIII	2	1910	221
"	"	4	1912	779
"	XII	5	1917	479
Fagaceae	VIII	2	1910	413
"	XIV	1	1924	73
Filices	VIII	"	1909	149
"	"	4	1912	715
Flacourtiaceae	"	"	"	671
"	XIV	2	1927	190
Flagellariaceae	"	"	"	180
Gentianaceae	VIII	1	1909	175
"	"	4	1912	889
Gesneraceae	"	2	1910	327
"	"	4	1912	859
"	XIV	2	1927	308
Gnetaceae	VIII	"	1910	345
"	XIV	"	1927	221
Gonystylaceae	"	"	"	306
Goodeniaceae	VIII	4	1912	693
Guttiferae	"	2	1910	309
"	"	4	1912	843
Haemodoraceae	"	5	1913	901
Halorrhagaceae	XIV	1	1924	105
Hernandiaceae	VIII	4	1912	639
Hippocrateaceae	"	2	1910	281

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Lauraceae	VIII	4	1912	819
Lecythidaceae	"	2	1910	315
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"	"	4	1912	815
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Lythraceae	VIII	4	1912	675
Magnoliaceae	"	"	"	633
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Meliaceae	VIII	"	1910	423
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"	XIV	1	1924	80
Monimiaceae	VIII	4	1912	876
Musci	"	"	"	735
"	XII	2	1914	109
Myristicaceae	VIII	4	1912	635
Myrtaceae	"	2	1910	319
"	"	4	1912	849
"	XIV	1	1924	85
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"	"	4	1912	629
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"	"	4	1912	681
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"	"	6	1914	1005
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Ranunculaceae	VIII	4	1912	631
Rhamnaceae	XIV	1	1924	110
"	VIII	2	1910	393
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"	"	4	1912	393
Rosaceae	"	4	1912	647
"	"	2	1910	367
Rubiaceae	"	3	1911	437
"	"	4	1912	755
"	XIV	2	1927	229
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"	"	4	1912	685
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SUBSTANZBEGRIFF UND SYSTEMATIK

VON

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Zusammenfassung: Bei der Einteilung der Organismen, welche in dieser Arbeit nur von botanischem Gesichtspunkt betrachtet wird, ist die Frage nach „wesentlichen“ Merkmalen oder Einteilungsgründen von grosser Wichtigkeit. Es ist die Frage nach der Substanz (Essenz) und den akzidentellen Merkmalen. Der Substanzbegriff entstammt der Aristotelischen Logik und Metaphysik. Aeltere Botaniker, die sich die prinzipiellen Grundlagen ihres Systems klarzustellen versuchen, sind z.B. CESALPIN und RAY. CESALPIN kommt in seiner Auffassung der Substanz ARISTOTELES sehr nah. RAY, obwohl öfters noch Aristotelisch beeinflusst, hat eine typisch empiristische Auffassung der Substanz, wodurch er sich den Ansichten LOCKES anschliesst. Auch in den modernen Theorien treten substantielle Formen auf. DRIESCH stellt seine Entelechie gleich Substanz, aber diese ist in der Systematik jetzt noch nicht anwendbar. VAVILOV hat in seinem Begriff „Radikal“ eine substantielle Form, die der Aristotelischen sehr nahe steht, indem sie durch Abstraktion dargestellt worden ist. Diese Form ist sehr brauchbar, sagt aber nur wenig aus. Von genetischer und physiologischer Seite versucht man Funktionsbegriffe einzuführen, welche jetzt aber in der Biologie nur eine sehr beschränkte Anwendung finden können. Ungeachtet ihrer Bedeutung, mit für die Systematik, kann man in letzterer Wissenschaft die festen, beharrlichen substantiellen Formen nicht entbehren, weil ohne diese jetzt noch keine Systematik möglich ist.

Inhalt.

- I. Einleitung.
- II. Substanzbegriff.
- III. Systematik.
- IV. Historisches. — CAESALPINUS. — LOCKE und RAY.
- V. Betrachtungen über einige modernen Theorien.

I. Einleitung.

Nichts liegt diesem Versuch weniger fern als Vollständigkeit. Eine historisch-kritische und systematisch-logische Untersuchung über die Bedeutung der Substanzkategorie für die botanische Klassifikation würde sich weit über das diesem Aufsatz gestellte Ziel hinaus erstrecken. In einer solchen Monographie sollten die Prinzipien der Systematik ein-

gehend berücksichtigt werden, und der Verfasser würde nicht umhinkönnen zu versuchen eine Lösung für das Problem zu geben.

Doeh vorliegende Arbeit will keine Ansprüche erheben. Sie gibt bloss einige durch die Betrachtung älterer und moderner Theorien angeregten Gedanken des Verfassers. Er glaubt, dass sich im Ringen um eine wissenschaftliche und natürliche Systematik mehrere Theorien vielleicht unter dem Begriff der Substanz und seiner Verwandlungen von einem gemeinsamen Gesichtspunkte aus fassen liessen. Dieser Gesichtspunkt wird sich an einigen historischen und modernen Theorien veranschaulichen. Indessen wird der Verfasser sich soviel wie möglich auf streng historischen Standpunkt stellen und auch die modernen Theorien gewissermassen als geschichtliche Tatsachen (d.h. ohne Stellungnahme ihnen gegenüber) betrachten. Vielleicht lässt sich später eine theoretische Begründung des angeführten Gesichtspunktes geben.

II. Substanzbegriff.

Bevor wir weiter gehen, sollen wir uns abfragen was unter „Substanz“ zu verstehen ist. Sogar für eine sehr knappe Darstellung, wie wir sie zu geben versuchen, kann man am besten auf ARISTOTELES selbst zurückgehen. Erstens weil der Substanzbegriff wesentlich seinen Ursprung in der peripatetischen Philosophie hat, zweitens weil diese Fassung des Substanzbegriffes für die Biologie die prägnanteste Bedeutung hat.

Substanz (*substantia*) dann ist ein Terminus, der sich in dieser besonderen Bedeutung bei den mittelalterlichen lateinischen Uebersetzern des ARISTOTELES findet, und wohl statt des griechischen *οὐσία*, welches Wesenheit (*essentia*) bedeutet¹⁾. Es ist ohne weiteres nicht ganz klar was ARISTOTELES selbst unter *οὐσία* verstanden hat. Wir schliessen uns in der Darstellung mehr oder weniger der P. H. RITTERS (29) an, und geben um die sachliche Auseinandersetzung zu verdeutlichen, als Beispiele einige Zitate des ARISTOTELES selbst²⁾.

Die beiden ersten Teile der Aristotelischen Logik handeln von den Kategorien und vom Satze. Der Satz (Urteil) ist einer der Hauptgegen-

1) Ob diese Uebersetzung berechtigt ist, lassen wir dahingestellt sein: Es handelt sich hier nicht um eine kritische Untersuchung des Substanzbegriffes im Mittelalter: nur um die Bedeutung welche dieser Begriff später erhalten hat.

2) Wir entnehmen die gesammten ARISTOTELES-Zitaten der Deutschen Uebersetzungen ROLFES und BUSSES in der *Philosophischen Bibliothek* (1, 2, 3, 4). Die Zusätze des Verfassers sind durch eckige Klammern angedeutet.

stände der Logik. Im Satze wird vom Subjekt etwas ausgesagt (Prädikat). Die „Hauptgattungen der Aussagen über das Seiende“ sind die Kategorien. ARISTOTELES hat acht, bezw. zehn Kategorien aufgezählt, als erste die Substanz (*οὐσία*), daneben die akzidentellen Kategorien, Qualität, Quantität, Relation, usw. Die im Prädikat begriffene Substanzkategorie kann aber nicht das Einzelding (Individuum) sein, denn vom Subjekt (= Einzelding) kann man (ohne Tautologie) nicht ein Einzelding aussagen. Die logische Substanzkategorie muss also der Art- oder Gattungsbegriff sein (*Nomen*). Das Subjekt als konkretes Einzelding (Individuum) wird von ARISTOTELES ebenfalls als *οὐσία* (Seiendes) bezeichnet (Vgl. unten die Erörterung über das metaphysische Substanzbegriff). Die erste Zweideutigkeit ergibt sich hier sogleich, indem sowohl das Einzelding als reales Substrat und Subjekt des Satzes, als der Gattungsbegriff *οὐσία* genannt werden. Zur Unterscheidung werden die Gattungsbegriffe daher als „zweite Substanzen“ (*δεύτεραι οὐσiai*) angedeutet. Dass ARISTOTELES die „zweiten Substanzen“ doch als Substanz bezeichnen kann, ist seiner Auffassung, dass „Art“ Subjekt der „Gattung“ usw. sein kann, zu verdanken.

Substanz im eigentlichsten, ursprünglichsten und vorzüglichsten Sinne ist die, die weder von einem Subjekt ausgesagt wird, noch in einem Subjekt ist, wie z.B. ein bestimmter Mensch oder ein bestimmtes Pferd.

Zweite Substanzen heissen die Arten, zu denen die Substanzen im ersten Sinne gehören, sie und ihre Gattungen. So gehört z.B. ein bestimmter Mensch zu der Art Mensch, und die Gattung der Art ist das Sinnenwesen [*ζῷον*]. Sie also heissen Substanzen, Mensch z.B. und Sinnenwesen.

..... — Ueberdies heissen die ersten Substanzen deshalb in vorzüglichem Sinne Substanzen, weil sie Subjekt von allem anderen sind und alles andere von ihnen ausgesagt wird. Wie sich aber nun die ersten Substanzen zu allem andern verhalten, so verhält sich auch die Art zu der Gattung. Denn die Art ist Subjekt der Gattung: die Gattungen werden von den Arten ausgesagt, aber die Arten nicht umgekehrt von den Gattungen. So folgt denn auch hieraus, dass die Art mehr Substanz ist als die Gattung (ARIST., *Kateg.* V) (1).

Nach ARISTOTELES hat nur die Substanz ein selbständiges Sein. Die anderen Kategorien haben ein Sein, das aber nicht von dem der Substanz trennbar ist. Die Substanz ist also ebenfalls Substrat, das die Eigenschaften trägt. In dieser Beziehung ist *substantia* (von *sub* und *stare*) die wörtliche Uebersetzung des Griechischen *ὑποκείμενον* (eig. das darunter Liegende)¹⁾. Die Substanzen können, im Gegensatz zu den

1) Wie ROLFES (4, p. 205) bemerkt, hat das Wort *ὑποκείμενον* bei ARISTOTELES zweierlei Bedeutung: erstens bedeutet es Materie, zweitens das „Dieses“, die Substanz, als Trägerin der Akzidenzien.

Akzidenzien, entgegengesetzte Eigenschaften annehmen, bleiben aber doch immer sich selbst (Identität). Die Akzidenzien aber kommen und gehen, und ändern sich nicht.

Am meisten aber scheint es der Substanz eigentümlich zu sein, dass sie, wie wohl der Zahl nach ein und dasselbe, für konträres empfänglich ist..... So wird z.B. ein bestimmter Mensch, obwohl er einer und derselbe ist, bald weiss, bald schwarz, warm und kalt, schlecht und gut (*Kat.* V) (1).

Dieser Eigenschaftsträger mag ARISTOTELES selbst wahrscheinlich nicht als eigenschaftslos gedacht haben.

Hier ergibt sich sogleich einen Uebergang vom logischen zum ontologischen Substanzbegriff. Eine schärfere Trennung der beiden lässt sich nur an sehr wenigen Stellen finden. Nicht z.B. an folgender:

Das Seiende wird vielfach ausgesagt, Denn ein Seiendes bezeichnet das Was eines Dinges und bezeichnet etwas als ein Dieses, ein anderes die Qualität oder sonst eine von den Kategorien. Da aber das Seiende so vielfach ausgesagt wird, so ist doch offenbar seine erste Bedeutung das Was, welches die Substanz bezeichnet. Denn wenn wir sagen, welche Qualität das und das hat, so nennen wir es gut oder schlecht, nicht aber drei Ellen lang oder Mensch, [die beiden letzten sind also nicht Qualität, sondern Quantität, bezw. Substanz]; sagen wir aber, was es ist, so nennen wir es nicht weiss oder warm oder drei Ellen lang, sondern Mensch oder Gott. Das andere aber wird Seiendes genannt, weil es an dem so Seienden etwas ist, Quantität, Qualität..... [usw.].

Und auch die von altersher wie gegenwärtig und allezeit aufgeworfene und nie genügend aufgehellte Frage: was ist das Seiende, bedeutet nicht anders als: was ist die Substanz? (*Met.* VII, 1) (4).

Dieses Zitat zeigt den Gegensatz zwischen dem an sich Seienden (Substanz) und dem nur an der Substanz Seienden. An dieser Stelle ist indessen vielmehr Metaphysik als Logik! Wir führen sie aber doch hier an, wegen des scharf formulierten Gegensatzes.

Mit der Erfassung dieses logischen Substanzbegriffes hat ARISTOTELES, wie SPRUYT (32) zurecht bemerkt, eigentlich nichts anderes als eine grammatische Bestimmung des gewöhnlichen Sprachgebrauchs gemacht. Vgl. auch VORLAENDER: „Seine Logik ist im Grunde genommen nur eine, in ihrer Art allerdings grossartige, Zergliederung und Systematisierung der Formen des Satzes“ (35, I, p. 132).

Daneben steht, in weitaus wichtigerer Bedeutung, die Substanz als metaphysischer Begriff. Das wahre Wesen der Dinge (Essenz), für PLATON die Idee, ist für ARISTOTELES etwas ganz anderes. Es ist das bestimmte Einzelding: dieser bestimmte Mensch, jenes be-

stimmte Pferd. Dieses ist also Substanz. Der fundamentale Gegensatz zu PLATON ergibt sich vielleicht deutlicher noch aus Folgendem: Für PLATON besteht das Allgemeine (die Idee) selbständig neben dem Vielen, aber nach ARISTOTELES „breitet es sich über das Viele aus“. „Damit verliert das Allgemeine die Selbständigkeit, die es bei PLATON als Idee hat. Es hört auf Subjekt zu sein, es wird immanent, Attribut. An seine Stelle tritt das Besondere, das Exemplar, das Einzelne als Subjekt. Und dieses ist Wesenheit, *ὄσις*, Substanz“ (RITTER (30), p. 82). In diesem Einzelnen sind Stoff und Form zusammengetreten. Stoff ist nicht Substanz, wie *Met.* VII, 3 gezeigt wird. Am Ende dieses Kapitels heisst es:

Da nun eingestandenermassen gewisse Substanzen der sinnlichen Dinge bestehen, müssen wir unter diesen zuerst unseren Begriff aufsuchen.

Wie nun RITTER ausführt hat der Substanzbegriff sich seit ARISTOTELES in drei Richtungen entwickelt, welche alle drei ihren Ausgangspunkt bei ARISTOTELES selbst haben. Substanz nämlich hat bei ARISTOTELES dreierlei Bedeutung, oder (vielleicht besser) dreierlei Ansicht:

Erstens ist die Substanz das Wirkliche, Aktuelle, als Form (s. o.).

Man fragt also nach der Ursache der Materie [z. B. „was ist ein Mensch“, was mit: „warum ist etwas ein Mensch“ (THOMAS V. AQUIN) gleichbedeutend ist], und das ist die Form, durch welche sie ein Was ist, und diese Form ist die Substanz (*Met.* VII, 17) (4).

Form ist hier eine „einfache Substanz“. — Neben dieser einfachen, gibt es auch noch zusammengesetzte Substanzen:

Was aber so aus etwas anderem zusammengesetzt ist, dass das Ganze eins ist, aber nicht so wie ein Haufe sondern wie eine Silbe, hat als Ganzes ein eigenes Sein. Denn die Silbe ist nicht die Buchstaben und ba nicht dasselbe wie b und a, auch ist das Fleisch nicht Feuer und Erde. Denn nach der Auflösung ist das eine, Fleisch und Silbe, nicht mehr vorhanden, wohl aber die Buchstaben und Feuer und Erde. Die Silbe ist also etwas; nicht bloss die Buchstaben, der Selbstlaut und Mitlaut, sondern noch etwas anderes; und das Fleisch ist nicht bloss Feuer und Erde, oder Warmes und Kaltes, sondern noch etwas anderes.

Jenes andere scheint daher etwas vom Element verschiedenes und die Ursache davon zu sein, dass dieses Fleisch und jenes Silbe ist. Und so ist es auch mit dem übrigen. Das aber nun ist die Substanz eines jeden; denn es ist die erste Ursache¹⁾ des Seins. Manche von den Dingen sind nun

1) Ursache wird hier in Aristotelischem Sinn aufgefasst als *causa formalis*.

freilich keine Substanzen; bei allem aber, was gemäss der Natur oder durch die Natur als Substanz besteht, muss diese Natur als Substanz erscheinen, die nicht Element, sondern Prinzip ist. Element aber ist, worin etwas als in seine materiellen Bestandteile zerlegt wird. Element der Silbe z.B. a und b (*Met.* VII, 17) (4).

Hier ist nun die zweite Form des Substanzbegriffes gegeben: das Prinzip, dass im Gegensatz zu den Elementen immer in derselben Form anwesend ist, das Beharrende im Fluss der Erscheinungen; also das, was sich selbst bleibt, indem die Akzidenzien wechseln. Hier also sind wir dem logischen Substanzbegriff am nächsten.

Die dritte Bedeutung der Substanz ist das Einzelne, Individuelle (s. o.), das aus Materie und Form, Potentialität und Aktualität, zusammengesetzte, z.B. die eiserne Kugel, die aus Bronze (Materie) und Form (Kugel) zusammengesetzt ist.

Man muss hierbei immer bedenken, dass, obwohl ARISTOTELES wesentlich eine ontologische Fragestellung hat, Logik und Metaphysik bei ihm noch immer, wenn auch weniger als bei PLATON, eng mit einander verknüpft und von einander durchdrungen sind. Das erleichtert unsere Frage nicht. Hiermit ergibt sich ein Gegensatz zu PLATON, dessen Fragestellung wesentlich eine erkenntnistheoretische ist. Bei ARISTOTELES überwiegt ein realistischer, naiver Standpunkt, mit einer starken Betonung der klassifizierenden Logik. In dieser Beziehung gilt die Definition als Wesensbestimmung. Zu einer entsprechenden Definition braucht man die Gattungs- und Artbegriffe, also wird das Wesen von der Klassenzugehörigkeit angedeutet. In diesem Punkte nun nähern wir uns den Prinzipien der biologischen Systematik, welche wir gleich betrachten wollen.

Es möge hier noch hervorgehoben sein, dass die Unklarheit des Aristotelischen Substanzbegriffes wesentlich auf die Verwischung von ersten und zweiten Substanzen zurückzuführen ist. Erst später hat sich eine begriffliche Trennung vollzogen, indem man die erste Substanz unterschied als Substrat, Träger der Akzidenzien, und die zweite Substanz (Gattungsbegriff) als Essenz. Es ist speziell diese letztere, die uns in den späteren Diskussionen interessiert.

III. Systematik.

Unter Systematik im weitesten Sinne wollen wir die Ordnung der zu einer Wissenschaft gehörenden Begriffe, Theorien und Axiome verstehen. In jeder Wissenschaft gibt es also einen systematischen Teil.

In der Philosophie, Theologie u.a.w., ist diese Bezeichnung sehr üblich. Das System steht hier didaktisch am Anfang, theoretisch am Ende der Wissenschaft. Auch in der Biologie hat man ein solches System, oder wenigstens Versuche zu einem solchen System zu geraten (z.B. BURCKHARDT, TSCHULOK, A. MEYER). In der Biologie hat aber der Terminus „System“ die prägnante Bedeutung der Ordnung der Organismen. Freilich ist die Bezeichnung in dieser Form nicht ganz korrekt, denn Organismen ordnet man z.B. in zoologischen Gärten, oder (konserviert) in Herbarien. Man möchte sagen: Systematik ist Ordnung der auf Grund des Studiums der Organismen gebildeten *Gattungsbegriffe¹⁾. In diesem Aufsatz nehmen wir den Terminus Systematik immer in dieser prägnanten Bedeutung. Hier ist Systematik gleich Einteilungswissenschaft, Taxonomie. Letzterer Terminus wird aber in der deutschen Sprache nur wenig angewandt.

Die biologische Systematik als Einteilungswissenschaft ist ein „rein logisches Geschäft“ (DRIESCH) (10). Wenn die *Spezies festgestellt sind, d.h. wenn man in bestimmter Weise eine Gruppe von Individuen als *Spezies bezeichnet hat, handelt es sich darum diese zu definieren, d.h. sie in das entsprechende **genus proximum* als nächst höheren, superordinierten Begriff einzuordnen. Von diesem **genus proximum* sollen dann auch alle höheren *Gattungen ausgesagt werden. Sagt man z.B. *Rosa canina*, dann wird von dieser Speziesbezeichnung ausgesagt, dass die Spezies zu der Gattung *Rosa*, diese zu der Tribus *Rosoideae* (**genus proximum* in Bezug auf die „Gattung“ im botanischen Sinn) und diese zu der Familie der *Rosaceae* gehört, usw. bis zu der letzt höchsten Gruppe (*Phylum*), etwa *Cormophyta*. — Um zu einem vollständigen System zu geraten soll man neben der Superordination auch die Koordination und die Subordination der *Gattungsbegriffe kennen. Für die Subordination gilt im grossen ganzen dasselbe wie für die Superordination.

Bei der Koordination nun werden Gruppen an einander angereiht, und unter einen gemeinsamen superordinierten Begriff gestellt, die logisch ganz gleichwertig sind. Für die höchsten *Gattungen

*) Mit einem * bezeichnen wir in diesem Abschnitt diejenige Termini, die in der Logik und Systematik beide vorkommen, wenn wir sie im Sinne der Logik verstehen wollen.

1) „Unter „Systematik“ wird immer noch nur die Ordnung der aus Individuen gebildeten höheren Gruppen verstanden“ (BURCKHARDT, (5), p. 391).

(Phyla) aber ist es weniger klar, dass sie gleichwertig sind. Beachtet man die Reihenfolge *Schizophyta*—*Cormophyta*, so leuchtet es ein, dass die Phyla zwar logisch wohl, inhaltlich aber nicht gleichwertig sind. Denn es ist hier eine Stufenfolge möglich, die zwar keine Superordination ist, aber doch vom Einfachen bis zum Komplizierten fortschreitet. Wie SCHAFFNER (30) es ausdrückt: Jedes folgende Unterreich (das indessen keine phylogenetische Bedeutung hat) ist um etwas reicher als das vorangehende. Es ist das für die Stämme vielleicht etwas zu simplistisch ausgesagt, und in besonderer Beziehung zu SCHAFFNERS Unterreiche, die sich nicht mit WETTSTEINS Stämmen decken, aufzufassen, aber die inhaltliche Ungleichwertigkeit als Prinzip bleibt ¹⁾. Man könnte hier vielleicht von einer Kontingenz der Phyla reden ²⁾. Immerhin sind die Phyla die Gruppen, die am leichtesten zu unterscheiden sind, weil sie untereinander ein Minimum übereinstimmender Merkmale haben.

Wir wollen hier nochmals hervorheben, dass wir den Terminus Systematik in dem üblichen, d.h. logisch nicht reinen, aber historisch gewordenen Sinn anwenden, und dass wir die an sich berechnigte Auseinanderlegung dieser Systematik in Diagnostik, Typologie und Phylogenie (A. MEYER) (18) ausser Betracht lassen. Nur die Phylogenie wird an einigen Stellen gesondert betrachtet werden. Immerhin ist in einer der in der Literatur am meisten angeführten Definitionen der Systematik, in der von R. WETTSTEIN (38) aufgestellten ³⁾, die Ver-

1) DRIESCH (10, S. 255) spricht von einem „Prinzip der Abstufung von Ähnlichkeiten und Verschiedenheiten“ als Grundlage des Systems der Pflanzen und Tiere.

2) Es ist in dieser Beziehung merkwürdig, dass LOTSY (17) auf das ausserordentlich hohe Alter der Phyla hingewiesen hat. Ist das Phylum einmal entstanden, dann wird der Bauplan allen folgenden Deszendenten in gleicher Weise weitergegeben.

3) „Aufgabe der systematischen Botanik ist die Feststellung der Pflanzen, welche jetzt existieren, sowie derjenigen, welche in frühern Perioden der Erdentwicklung lebten, und der Versuch, sie zu einem System zu gruppieren; dieses System soll einerseits der wissenschaftlichen Forderung gerecht werden, eine Darstellung der entwicklungsgeschichtlichen Beziehungen der Pflanzen zu einander zu geben, andererseits dem praktischen Bedürfnisse nach Uebersicht entsprechen“. Man vergleiche auch CESALPINs Bemerkung: *qui autem secundum naturarum societatem assignatur, omnium facilius reperitur, tutissimus, utilissimusque ad memoriam,*

knüpfung von Diagnostik und Phylogenie besonders hervorgehoben.

Die Auflehnung gegen eine derartige Kontamination hat sich in den letzten Jahrzehnten besonders geltend gemacht. Einerseits war dazu die oben angeführte logische Vertiefung der Wissenschaftseinteilung von Bedeutung, andererseits die Schwierigkeit den Verlauf der Phylogenie einwandfrei festzustellen, überdies die Behauptung, dass es nicht möglich sei zu einer wissenschaftlichen Darstellung der Phylogenie zu geraten¹⁾. Die Kontamination hat weniger logische, als vielmehr psychologische Ursachen. Wenn auch Diagnostik, Typologie und Phylogenie logisch kontingente Wissensgebiete sind (A. MEYER), so gibt es wohl kaum einen Diagnostiker, der in dem reinen Beschreiben und Unterscheiden genüge fände. Wenn er nicht all zu beschränkt ist, greift er über sein Spezialgebiet hinaus und wendet sich mehr theoretischen Wissenschaften zu. Und eben der gewandte Diagnostiker hat schon eine grosse Tatsachenmenge und Einsicht in Uebereinstimmungen und Verschiedenheiten zu seiner Disposition, durch die er in der Typologie oder Phylogenie bald erfolgreich arbeiten kann. Allerdings darf man dabei nicht übersehen, dass der „Blick“ des Diagnostikers in anderer Weise „schaut“ als der des Typologen oder Phylogenetikers. Aber für alle drei ist eine gewisse „eidetische“ Veranlagung von grosser Wichtigkeit.

Die für unsere Betrachtung wichtige Frage ist die nach den Einteilungsgründen der heutigen Systematik. Diese werden bekannterweise zum überaus grössten Teil den morphologischen Eigentümlichkeiten der Pflanzen entnommen. Für die *Phyla* sind dabei Generationswechsel, Fortpflanzung, usw. von Wichtigkeit. Für die Unterscheidung niederer *Gattungen dienen Zahl und Beschaffenheit der Organè.

Es fragt sich nun sofort ob alle Merkmale oder Merkmalgruppen für eine Einteilung von gleicher Wichtigkeit sind. Eine einfache Betrachtung der Geschichte der Systematik führt zu der Ansicht, dass dies nicht der Fall ist. Eine weitere logische Ueberlegung ergibt, dass es „wesentliche“ und mehr oder weniger „unwesentliche“ Merkmale gibt. ZIEHEN (*Logik*) (40) unterscheidet übereinstimmende, ähnliche und gänzlich verschiedene Merkmale, symbolisch bezw. mit m, o, q bezeichnet. Für die Diagnostik haben nun im allgemeinen die q-Merkmale, für die Typologie die m-Merkmale, die grösste Bedeutung. Aber von „wesentlich“ darf man dabei noch nicht reden. „Wesentlich“ im Sinne der

1) Man muss aber dabei erwägen, dass die Phylogenie der Methode nach keine Naturwissenschaft, sondern Geschichtswissenschaft ist!

Logik ist das, was zur Unterscheidung dienen kann. An erster Stelle also die o- und q-Merkmale. Aber eine zweckmässige Definition kann nicht immer die unendliche Reihe all dieser Merkmale ausdrücken. Es kommt dann darauf an eine Auswahl zu treffen. Für diese Auswahl aber gibt es keine allgemein-gültige logische Regel. Es gibt also keine „absolut wesentlichen“ Merkmale. Der Zweck der Untersuchung (hier das „natürliche“ System) spielt eine entscheidende Rolle. Man kann daher nur sagen: Welche Merkmale sind in Bezug auf die zum Aufbau des natürlichen Systems notwendigen Unterscheidungen wesentlich?

Die Frage nach Substanz und Akzidenzien, nach wesentlichen und unwesentlichen Merkmalen, hat nun immer als Grundfrage der Systematik gegolten. Die Antwort auf diese Frage aber steht zu jeder Zeit in engem Zusammenhang mit der damaligen Situation der Wissenschaften.

Gerade die beiden Botaniker CESALPIN und RAY, denen wir den historischen Teil dieser Arbeit widmen, unterscheiden, vielleicht von ihrem metaphysischen Standpunkt geführt, absolut wesentliche und akzidentelle Merkmale, indem sie versuchen eine *definitio essentialis* zu geben. Was sie in Bezug darauf ausgeführt haben, wollen wir in dem nächsten Abschnitt betrachten.

IV. Historisches.

Soll man die Anwendung des Substanzbegriffes in der Systematik untersuchen, so wählt man am besten diejenigen Botaniker, die sich der Prinzipien ihrer Systematik explizit Rechenschaft ablegen. Es ist kaum möglich aus blossen Tabellen oder Conspectus eine Idee von den leitenden Prinzipien zu bekommen. In diesem Aufsatz beschränken wir uns auf zwei ältere Forscher, auf CESALPIN und RAY. Sie gehören einem ganz verschiedenen Ideenkreis an, haben aber beide ein mehr oder weniger zeitgemässes philosophisches System, wodurch sich die theoretischen Auseinandersetzungen über ihre Klassifikation im Rahmen einer Philosophie, in welcher die Stellungnahme zum Substanzbegriff bekannt ist, betrachten lassen.

ANDREA CESALPINI (1519—1603) ist vielleicht der ausgezeichnetste Peripatetiker nach ARISTOTELES. ARISTOTELES steht vor ihm als die grosse Autorität, auf dessen Sätzen sich alle Philosophie und Wissenschaft überhaupt gründen lässt. Wenn er auch ergriffen ist von den modernen Ideen der neuern Zeit, die sich faktisch öfters denen des ARISTOTELES entgegenstellen, so wird die Autorität des Stagyrten dadurch nicht erschüttert, sondern sie bleibt ebenso fest gegründet, weil CESALPIN die neuen Tat-

sachen aus der Lehre des Meisters zu rechtfertigen versucht. Wenn auch autoritär sich an ARISTOTELES haftend, ist er ein Forscher von grosser Selbständigkeit, indem er sich einen eigenen ARISTOTELES schafft, frei von allem Ueberlieferten des Mittelalters. Dass er eben in dieser Zeit nicht auf Ketzerei verklagt worden ist, sondern vielmehr einen Ruf an den päpstlichen Hof erhalten hat, muss Verwunderung erregen.

Es wundert kaum, dass sich in den Arbeiten eines so konsequenten Aristotelikers fast überall Erörterungen über den Substanzbegriff finden lassen. Ausser medizinischen Arbeiten hat CESALPIN ein Buch über die Botanik geschrieben (7). Seine Erstlingsarbeit dagegen, die *Quaestiones Peripateticarum* (8, 9), eine *Summa philosophiae* — bis jetzt wenig beachtet — muss vielleicht als sein Hauptwerk betrachtet werden.

Bekanntlich ist das Pflanzensystem CESALPINS, obwohl ein durchaus künstliches, das erste System mit wissenschaftlichen Prinzipien. CESALPIN sieht das System der Pflanzen als höchstes Ziel der Botaniker: „die Einteilung der Pflanzen nach Unterschieden, welche die Natur des Dinges andeuten“ (7, S. VI). Die Einteilung der Pflanzen soll nicht in irgendeiner beliebigen Weise geschehen, aber sie soll natürliche Verhältnisse andeuten. Die (damals sosehr üblichen) alphabetischen Systeme, die Einteilungen nach medizinischen Eigenschaften (DIOSKORIDES) oder Standorten (THEOPHRAST) sind daher zu verwerfen. Man soll zweckmässige Gattungen¹⁾ haben, denn ohne diese verwirrt sich alles; hat man etwas nicht in der zutreffenden Gattung untergebracht, so kann eben die genaueste Beschreibung irreführen. Eine natürliche Ordnung hat die grössten Vorteile, da sie am leichtesten im Gedächtnis zu behalten ist; ausserdem sind die Unterschiede so am auffälligsten, und werden die medizinischen Kräfte so am besten betrachtet. In diesem System kann man für alle Pflanzen, auch für die neuen, die entsprechenden Stellen sogleich ausfindig machen.

Die Grundsätze nun auf welchen ein solches System zu gründen ist, werden im zwölften und dreizehnten Kapitel des ersten Buches *De Plantis* erörtert. Es ist für einen Peripatetiker wie CESALPIN selbstredend, dass er dabei von den Substanzen ausgehen soll. „Wir suchen nun die Uebereinstimmungen und Verschiedenheiten der Formen, in welchen die Substanz der Pflanzen besteht, nicht derjenigen, die ihnen akzidentell

1) Wir bemerken noch, dass bei CESALPIN und RAY die Termini Art und Gattung immer in logischem Sinn angewendet werden. Erst bei LINNÉ tritt die jetzt in der Botanik übliche Bedeutung auf.

sind, denn die Akzidenzien werden erst später bekannt als die Substanz'' (d.h. sind logisch später als die Substanz) (7, S. 26). Heilkraft, Anwendung, Standort usw. sind nur Akzidenzien. „Der Seinsgrund der Substanz nun ist unbekannt, weil die äussersten Unterschiede unbekannt sind, und so meinen manche, dass man deshalb nach den Akzidenzien einteilen soll'' (7, S. 27). Das ist eben nicht peripatetisch, sagt ARISTOTELES ja: „Wenn nun der Unterschied unterschieden wird, so wird einzig der letzte die Form und die Substanz sein; teilt man aber nach akzidentellen Unterschiede ein, ..., so bekommt man so viele Unterschiede als Einteilungen'' (*Met.* VII, 12) (4). Man kann auch nicht die grösste Anzahl übereinstimmender Teile (Merkmale) als Einteilungsgrund nehmen, denn auf diese Weise werden kongenerischen Pflanzen oft voneinander entfernt, und wird die Bildung höherer Gattungen (*genera superiora*) unmöglich. Diese Sätze werden überdies in den *Quaestiones Peripateticarum* (8) (L. I, qu. 5) ausführlich erörtert. Wichtiger ist der Einteilungsgrund nach der aus der Seele hervorgehenden Form. Für die lebendigen Körper sind nämlich Seele und Substanz etwa gleichwertig. Man kann das der Schrift des ARISTOTELES „*Ueber die Seele*'' (3) entnehmen, wo es z.B. heisst: „Also muss die Seele Wesenheit (Substanz) sein als Form eines natürlichen der Möglichkeit nach belebten Körpern''; und: „Die Seele ist nämlich das begriffliche Wesen, d.h. das eigentümliche Sein [Substanz] eines so und so beschaffenen Körpers'' (*Ueber die Seele*, II, 1) (3). Man könnte denken, dass in dieser Weise alle Pflanzen nur zu einer Gattung gehören könnten, weil sie alle aus einer selben *anima vegetativa* hervorgegangen sind. Dann sollten aber auch die Teile, welche die Funktionen eines bestimmten Teiles der Seele verrichten, bei allen Pflanzen nicht verschieden sein. Die Pflanzen sind aber verschieden; und so kommt CESALPIN darauf, dass es notwendig ist sie in Gattungen und Arten einzuteilen. Um zu diesem Ergebnis zu gelangen, wäre vielleicht die ganze vorangehende Erörterung überflüssig gewesen, sie hat jetzt aber zur Erwidern einiger falschen Auffassungen dienen können.

Ein allgemeiner Satz nun ist, dass wenn eine Substanz ist, auch diejenigen Substanzen sind, welche den ersten zur Verfügung gegeben sind. Bei den Pflanzen soll das so aufgefasst werden, dass die Uebereinstimmungen und Verschiedenheiten sich in denjenigen Dingen finden lassen, die zu Gunsten der Funktionen der ersten Seele gegeben sind, zweitens in denen, welche zu Gunsten der Funktionen der zweiten Seele da sind, usw. — Die zwei wichtigsten Funktionen der vegetativen Seele sind in dieser Be-

ziehung: die Ernährung und die Fortpflanzung¹⁾. Die Ernährung einschl. Wachstum steht an erster Stelle. Zur Nahrungsaufnahme und zum Wachstum dienen Wurzel und Spross. Aus ihrer Beschaffenheit sollen die Differenzen zur Einteilung in „erste Gattungen“ hervorgehen. Die Pflanzen mit harter „Substanz“²⁾ werden als Bäume und Sträucher bezeichnet, die mit zärterer „Substanz“ als Kräuter und Halbsträucher. Diese Differenz wird aus der Natur der gleichartigen Teile erlangt, die die ganze Pflanze zusammensetzen. Eine zweite Differenz ergibt sich aus dem Spross: Ist er einfach, so haben wir Bäume und Kräuter; ist er verzweigt, Sträucher und Halbsträucher. CESALPIN meint aber besser zu verfahren indem er diese zweite Differenz vernachlässigt, weil sie eine weniger klare Disposition gibt. Er kommt also schliesslich zu zwei höchsten Gattungen: *Arbores (incl. Frutices)* und *Herbae (incl. Suffrutices)*. — Man könnte nun aus den andern Unterschieden (wie Gestalt, Farbe usw.) dieser Teile der ersten Funktion eine weitere Einteilung erhalten, aber das ist nicht erlaubt, da dieses mittels der Organe der zweiten Funktion geschehen soll.

Die zweite vegetative Funktion ist die Generation des Gleichartigen, welche aber der Vollkommenheit nach die erste ist. Die Frucht und die Fruktifikationsteile sind dieser Fortpflanzung zur Verfügung gegeben. Da diese nicht allen Pflanzen, sondern nur den vollkommenern zukommt, sind sowohl im Geschlecht der Bäume als in dem der Kräuter niedere Gattungen nach der Aehnlichkeit und Verschiedenheit der Früchte aufzustellen. Merkwürdig ist die Bemerkung CESALPINS, dass nichts daran gelegen sei, ob die Gattungen wohl oder nicht mit Namen versehen sind, weil doch nur diejenigen einen Namen erhalten haben, welche von dem Menschen aus irgendwelchem Grunde benutzt werden.

Es gibt sonst keine weiteren als diese beiden Funktionen der vegetativen Seele, und deshalb auch keinen dritten Modus zur Zerteilung der

1) Nicht nur CESALPIN hat diese beiden Funktionen als wichtig für das Leben anerkennt. Zeitgenossen und Nachkommen haben öfters auch diese beiden angeführt. In einer statistischen Zusammenstellung der für die Definition des Organischen angewendeten Modale hat A. MEYER diese beiden Funktionen als die häufigsten gefunden (18).

2) Wie bei ARISTOTELES selbst hat bei CESALPIN „Substantia“ zuweilen die Bedeutung Materie. Materie kann *ὁποκείμενον* sein. Man muss aber bedenken, dass Materie in Aristotelischem Sinn (also auch bei CESALPIN) nicht an erster Stelle etwas Stoffliches bedeutet, sondern Potenz (im Gegensatz zu Form = *anima* = Aktualität). — Hier bedeutet Substanz wohl etwa „Wesenheit“, die sich aber in diesem Fall auf Eigenschaften der Materie gründet.

höchsten Gattungen. Aber, wie CESALPIN bemerkt, „sind mit Recht viele Pflanzengattungen nach der Fruktifikationsweise aufgestellt. Denn in keinen anderen Teilen hat die Natur so viel Mannigfaltigkeit und Verschiedenheit der Organe gelegt, als in den Früchten zusammengebracht angeschaut wird“ (7, S. 28). — Nur diejenigen Funktionen der Seele, welche sich der Werkzeuge bedienen, können als Einteilungsgrund dienen: die Vernunftseele (νοῦς) des Menschen z.B. hat keine materiellen Organe, und deshalb gehören alle Menschen nur einer Spezies an, und geschieht die Einteilung (vielleicht besser: die Bezeichnung) nach den Akzidenzien. Dasselbe kann man bei gewissen Pflanzen einsehen, die der Spezies nach als verschieden aufgefasst werden. Es gibt also noch andere Einteilungsgründe als die der Substanzen, nämlich die der *propria*¹⁾, die für die Fruktifikation vorhanden sind.

Nicht jede Pflanze ist im Stande sich fortzupflanzen: die Unvollkommenen, die der inorganisierten Welt am nächsten stehen (z.B. *Fungi*) können ihres Gleichen gar nicht erzeugen (entstehen durch *generatio spontanea*), können also nur wachsen und sich ernähren²⁾. Andere Pflanzen scheinen wohl Samen zu produzieren, jedoch in unvollkommener Weise (so wie unter den Tieren das Maultier), meistens sind das Degenerationen und Krankheiten anderer Pflanzen. Man soll aber die vollkommenen Pflanzen, die steril sind, nicht in diese Klasse einordnen, kommt die Unvollkommenheit ja hier nicht der Spezies zu, sondern dem Individuum³⁾; das Vermögen eine Frucht auszubilden ist also potenziell anwesend. Die übrigen können also nach der Beschaffenheit der Frucht eingeteilt werden. Die Gründe dazu sind für unsere Betrachtungen weniger wichtig. Sie werden im 14. Kapitel erörtert. Hier sei noch bemerkt, dass CESALPIN unter den Organen ausserhalb der Frucht solche unterscheidet, die *per accidens* da sind, d.h. die nichts mit der Frucht zu schaffen haben, und solche die *per se* da sind, d.h.

1) *Proprium* (Eigentümlichkeit) ist, nach ARISTOTELES (*Τοπικ*), was zwar nicht das Wesen eines Dinges bezeichnet, aber nur ihm zukommt und in der Aussage mit ihm vertauscht wird. Nach PORPHYRIUS (*Einl. z. d. Kateg.*) (22) unterscheidet sich das *Proprium* von Differenz und Akzidenz dadurch, dass es nur eine gewisse Art innewohnt. („Das *Proprium* aber gilt nur von einer Art, deren *Proprium* es ist“, a. W. XIII).

2) Man vergleiche LENNÉ'S Satz: *Lapides crescunt, vegetabilia crescunt et vivunt. Animalia crescunt, vivunt et sentiunt* (*Phil. bot.* N. 3), die übrigens rein Aristotelisch ist!

3) Vgl. unten bei RAY, S. 177.

die in irgend einer Weise der Ernährung, Verbreitung oder dem Schutz der Frucht dienen. Letzteren dienen dann (mit denen, die aus der Fruktifikation selbst hervorgehen) der Einteilung in unteren Spezies. Die Merkmale, welche gar nicht der Konstitution der Pflanze oder Frucht dienen (Farben, Geruch, Geschmack) sind akzidentell, sie variieren durch äussere Faktoren. Die Merkmale, die *per se* da sind, sind unter allen Umständen gleich. Einige aber dieser (z.B. medizinische Eigenschaften) folgen der spezifischen Natur. Dies sind aber nach CESALPIN keine Differenzen, die die Substanz zusammenstellen.

Die eigentliche Einteilung der Pflanzen geht aus seinem Buch nur wenig deutlich hervor, für unsere Betrachtungen hat sie auch weniger Bedeutung; nur das Prinzip ist wichtig. Eine gute Uebersicht der Einteilung selbst gibt LINNÉ, *Cl. Pl.* p. 3—31. Die Bäume werden von CESALPIN im zweiten und dritten Buch behandelt, die Kräuter in den Büchern IV—XVI.

Kurz gefasst kann man sagen, dass der Substanzbegriff CESALPINS sich dem des ARISTOTELES vor allem darin anschliesst, dass er als Träger der akzidentellen Eigenschaften betrachtet wird. Die Begriffe der Substanz und der Seele aber sind eng mit einander verwandt, was auch sehr Aristotelisch ist (Vgl. *Ueber die Seele*) (3). In dieser Hinsicht könnte man die Substanz am besten als *causa materialis* der Seele (teleologisch) auffassen: sie ist zugunsten der Seele gegeben. CESALPIN hat sogar in einem Caput der *Quaestiones peripateticarum* (8) die Bedeutung der Substanzen auf die lebendigen Körper beschränkt!

JOHN RAY (JOANNES RAIUS, 1628—1705) ist zweifelsohne der prominenteste Botaniker Englands im XVII. Jahrhundert. Vielfach wird MORISON grössere Originalität zugeschrieben, aber demgegenüber steht, dass RAY den grössten Einfluss auf seine Zeitgenossen und Nachkommen ausgeübt hat. Dazu kommt noch, dass RAY auch auf anderen Wissensgebieten erfolgreich arbeitete, und speziell in der Zoologie und Botanik grössere Werke verfasst hat, die das ganze XVIII. Jahrhundert hindurch ihren Wert als Nachschlagebücher bewahrt haben. Für unsere Betrachtungen haben wir aus den theoretisch ausgebildeten Systematikern, die für eine bestimmte Epoche (und hier auch für einen bestimmten Volkscharakter) bezeichnend sind, RAY zur Besprechung gewählt. Das theoretische Interesse verdankt RAY vielleicht seiner literarischen Veranlagung und daneben noch seiner theologischen Ausbildung. In dieser Hinsicht steht er auf der Grenze zweier wissenschaftlichen Methoden: des über-

lieferten Aristotelismus und des Empirismus. Aus ersterer geht seine Verknüpfung mit der Vergangenheit und seinen Präzeptoren hervor; in seinem Empirismus beweist er seine Landesart als Engländer. In dieser Beziehung hat er eine gewisse Uebereinstimmung mit seinem Zeitgenossen JOHN LOCKE (1632 -1704), dessen philosophische Ansichten gleich dargestellt werden. Soweit uns bekannt ist, sind die methodischen Aehnlichkeiten RAYS und LOCKES, die in einigen Fällen auch zu denselben Fehlschlüssen führen, niemals hervorgehoben worden. Es ist dem Verfasser nicht bekannt ob RAY und LOCKE sich Zeit ihres Lebens persönlich oder schriftlich kannten. In der von der RAY-society ausgegebenen Korrespondenz RAYS (27, 28) und in seiner Biographie (26) wird LOCKES Namen in diesem Zusammenhang nicht erwähnt.

Der Verfasser ist geneigt zu denken, dass dieser Parallelismus sich in der Tatsache gründet, dass LOCKES Erkenntnistheorie weniger eine Neuschöpfung, als eine Wiedergabe der herrschenden zeitgemässen Ansichten seines Volkes ist.

Bevor wir nun RAYS systematische Prinzipien einer Besprechung unterwerfen, geben wir eine kurze Erörterung der Philosophie LOCKES, soweit sie für unsere Betrachtungen wichtig ist. LOCKE (16) findet den Ursprung aller Erkenntnis in der Erfahrung; weil er dabei den Nachdruck auf unsere Sinneswahrnehmungen legt, hat man seine Philosophie wohl als *Sensualismus* bezeichnet. Die Tatsachen der Erfahrung werden der äusseren und inneren Wahrnehmung (*sensation* und *reflexion*) entnommen. Nur erstere gibt uns die Erkenntnis der uns umgebenden Welt, nämlich in der Form der primären und sekundären Qualitäten. Aus der Erfahrung bekommen wir die s.g. einfachen Vorstellungen (*simple ideas*). Diese einfachen Vorstellungen sind Eindrücke, die die Aussenwelt auf den Geist einprägt, bei denen der Geist also gänzlich passiv ist. Daneben gibt es zusammengesetzte (*complex ideas*), die durch die Wirksamkeit des Geistes aus den einfachen Vorstellungen hergeleitet werden. Da LOCKE nur den Erfahrungstatsachen Wirklichkeit zuerkennt, sind diese zusammengesetzten Vorstellungen blosser Abstraktionen. In dieser Beziehung ist LOCKE Nominalist, weil er unsere Wörter nur als Zeichen für unsere Vorstellungen, aber nicht für die Dinge selbst betrachtet. Die Natur schafft die Individuen, die der Mensch mittels der von ihm selbst erdachten Gattungsbegriffe einteilt. Zu diesen zusammengesetzten Vorstellungen gehören auch die der Substanzen (*complex ideas of substances*). Die Substanz nach der Auffassung LOCKES ist ein unbekanntes Prinzip, dessen Wirkung wir erkennen können, von welchem

wir aber nicht wissen, was es ist. Die Substanz bewirkt, dass wir bestimmte einfache Vorstellungen immer verbunden zu einer Einheit erfahren. In diesem Sinn ist also Substanz = Substrat, Träger der Akzidenzien. Nur letztere werden uns bekannt, weil sie die einfachen Vorstellungen hervorrufen. Indessen kann man der Substanz eine gewisse Realität nicht absagen: diese ist ektypisch (= abbildlich), weil sie die Verknüpfung der einfachen Vorstellungen genau so gibt wie sie erfahrungsgemäss verbunden in der Natur vorkommen. Nun kommt LOCKE alsbald auf den Begriff des Nominalwesens (*nominal essence*). Nehmen wir eine bestimmte Gruppe von Qualitäten zusammen unter einer abstraktiven zusammengesetzten Vorstellung (*abstract complex idea*), so hat diese die Bedeutung einer Essenz: z. B. gelbe Farbe, Schmiedbarkeit, Löslichkeit in Königswasser, usw. bilden die „Essenz“ des Goldes, d. h. desjenigen, das wir mit dem Namen Gold belegen. Diese Nominalessenz wird von dem Geiste gebildet, deshalb ist sie veränderlich, denn man kann noch eine beliebige Anzahl Eigenschaften hinzufügen, ohne dass der ganze Vorrat dieser Eigenschaften erschöpft wird. Das Realwesen (*real essence*) entzieht sich der Erkenntnis, es ist die Grundlage aller Eigenschaften, die in der Nominalessenz zusammengebracht sind, und regelmässig mit ihr vorkommen¹). Diese Realessenz wird wahrscheinlich etwa in atomistischer Weise gedacht: wenn wir die kleinsten zusammensetzenden Teile der Körper in ihren primären Eigenschaften erkennen könnten, würde sich zweifelsohne eine Auflösung der sekundären Eigenschaften (Akzidenzien) der Körper ergeben. Obwohl die Realessenz unbekannt ist und bleiben wird, kann man ihr näherkommen durch die Erkenntnis der Nominalessenz, die indessen immer nur ein unvollständiges Abbild des Realwesens ist. In Bezug auf die Realessenz ist LOCKE wieder Realist. Dieser Widerspruch ist einer der vielen die sich in seinem *Essay* finden!

Man mag über LOCKE denken wie man will: er hat, wie DE SOPPER (31) bemerkt, das Wort seiner Zeit gesprochen. Er ist ein typischer Philosoph der „*common sense*“, und hat dadurch einen grossen Einfluss ausgeübt, während die Widersprüche seines Systems weniger beachtet wurden. In dieser Beziehung braucht es nicht zu wundern, dass wir Sätze LOCKES oft fast wörtlich bei vielen Forschern wiederholt finden.

1) Gleiches sagt etwa auch RAY, *Hist. Pl.* I, cap. XXVI (24), wo es heisst, dass wohl niemand mit einem Blick alle zur Vergleichung notwendige Uebereinstimmungen und Verschiedenheiten umfassen kann.

Wir wenden uns nun dem Botaniker RAY zu, und wählen als Ausgangspunkt seine *Dissertatio nova de variis Plantarum Methodis* (25). Gelegentlich kommen wir noch über seine andern Arbeiten zu reden. Schon in den Anfangssätzen der *Dissertatio nova*, wo steht, dass in der Natur nur Individuen existieren und dass es Begriffe (Universalien) nur im Geiste des Menschen gibt, ist eine Parallele zu LOCKES Ansichten zu ziehen. Das zweite Kapitel (*Ueber die kennzeichnenden Merkmale der Gattungen*) fängt sogar mit der Bemerkung an, dass das Wesen (Essenz) der Dinge uns unbekannt sei, und dass all unsere Erkenntnis aus den Sinnen hergeleitet werde. Wir wissen nichts von den Dingen ausser uns als das, wodurch sie unsre Sinne zu reizen vermögen: die „Eindrücke“ rufen in unserm Geiste bestimmte Vorstellungen auf, usw. Der Gesichtssinn, der unter allen Sinnen der feinste ist, ist nicht im Stande uns die kleinsten Theilchen der Körper zu offenbaren, was z.B. für die durchscheinenden Körper sogleich einleuchtet.

Weil die Essenzen unbekannt sind, können wir auch die wesentlichen Gattungsmerkmale nicht ermitteln. Hier ergibt sich sofort einen Anschluss an LOCKES Nominalismus. Man könnte hieraus schliessen, dass eine natürliche Klassifikation gar nicht möglich sei: hier macht RAY jedoch einen gleichen Notsprung wie LOCKE, indem er annimmt, dass die Uebereinstimmung möglichst vieler Akzidenzien wohl doch auf ein wesentliches Zusammengehören hinweisen wird. Es fragt sich hier aber, welche Teile der Pflanzen man als die essentiellen betrachten muss. Dabei stellen RAY und LOCKE dieselben Ansprüche an die Essenz: sie soll beharrend, und immanent sein. Deshalb kann die Essenz ihren Sitz nicht in der Blüte oder Frucht haben: es gibt zu viele Pflanzen, die diese ganz vermissen, und zu viele (z.B. Bäume), die diese erst spät ausbilden. Auch die P o t e n z, Blüte und Frucht ausbilden zu können, kann man nicht als Essenz betrachten ¹⁾, denn diese ist etwas Unsichtbares und nicht durch die Sinne Wahrnehmbares. Die Essenz muss aber zu jeder Zeit wahrnehmbar sein, denn sonst könnte man nicht wissen welche Art man vor sich hat ²⁾ (Beispiel des Nussbaumes). Hier voll-

1) CESALPIN hat diesen Einwand gerade als unwichtig beseitigt.

2) Wie bei LOCKE scheint hier der Name Ausdruck einer Essenz (des Nominalwesens) zu sein. Merkwürdig ist, dass LOCKE das dritte Buch seines *Essays* der Sprache und deren Einfluss auf das Denken widmet, während RAY in dem ersten Kapitel (*Vom Ursprung und Fortschreiten der „Methode“*) der *Dissertatio nova* ausführt, dass die Sprache und „Methode“ beide ihren Ursprung im „Namengeben“ finden!

zieht sich allmählich ein Umschwung zum Realismus, der in dem Vorworte der *Dissertatio* vollzogen ist. Obwohl RAY zustimmt, dass die Universalia Bildungen des menschlichen Geistes sind (*post rem*), so kann er nicht leugnen, dass sie ihre Grundlage in den Dingen („*in re*“) haben! Die Individuen einer und derselben Spezies scheint der göttliche Geist nach einer selben Idee (oder Vorbild) geschaffen zu haben (*universalia ante rem*!). Das war die Arbeit der Schöpfung am Anfang der Welt. Von jener Zeit an geben die Samen die spezifische Form immer auf die gleiche Weise weiter (Samen sind kleine Pflänzchen, mit der Mutterpflanze verwandt, aber ohne Kontinuität mit dieser). Die spezifischen Essenzen werden also als materielle unteilbare Partikeln (wie λόγοι σπερματικοί!) weitergegeben (Vgl. S. 183). Eine derartige spezifische Konstanz behauptet er *Hist. Pl.* I, cap. XX, als er bemerkt, dass Gott am sechsten (!) Tage von seinem Werke, d.h. von der Schöpfung neuer Spezies (!), ausgeruht habe, und deshalb die Anzahl der Spezies beschränkt sei. Indessen ist RAY von der fortwährenden Entstehung neuer Formen überzeugt. Aber auf Grund des angeführten Gesichtspunktes kann er diesen keinen spezifischen Wert zuerkennen. Es sind eben meistens Varietäten, oder Spielformen, die er als Beispiele anführt. Man kann in dieser Beziehung gerade den Satz, dass die Natur keinen Sprung mache, und von einem Extrem nur über die Mitte nach dem anderen gehe, nicht etwa als ein Hindenten auf die Deszendenztheorie betrachten. Er ist bloss der Ausdruck dafür, dass es keine scharfe Speziesunterscheidung gibt. Nach LOCKE kann die Unveränderlichkeit der Essenzen nur so lange aufrecht erhalten werden, als derselbe Name dieselbe Bedeutung haben kann. RAY meint auch, dass die Veränderung der Dinge neue Namen mit sich führen wird, man darf das aber unserer Meinung nach nicht dynamisch auffassen. Es handelt sich hier, wenigstens bei LOCKE, nur um Vorstellungen, die sich ändern! PFLEIDERER bemerkt dazu, dass das „der ächt englische, zuerst *logisch metaphysische*, dann naturwissenschaftliche Darwinismus“¹⁾ sei.

Wie CESALPIN, versucht auch RAY die überlieferte Haupteinteilung in Bäume und Kräuter zu begründen. Er hat aber, seinem verschiedenen Standpunkte gemäss, ganz andere Argumente. Einerseits gilt ihm hier die Uebereinstimmung mehrerer Attribute, andererseits die „sichere und augenscheinliche“ Merkmale, welche von jedem Botaniker anerkannt werden. Das ist eben ein Argument des „gesunden Verstandes“. —

1) Zitiert nach DE SOPPER (31), S. 60. Kursivierung von uns.

Trotz seiner früheren Einwände behält er diese Einteilung bei. Was die weitere Ausbildung des Systems anbelangt, kann er diese nur mittels der Akzidenzien erreichen. In dieser Hinsicht ist seine Behauptung, dass aus derselben Essenz dieselben Attribute hervorgehen, wichtig. Gewissermassen ist das eine Folgerung der Substanzenlehre LOCKES, wo nämlich auf die Existenz einer Nominalessenz durch das anhaltende Verbundensein mehrerer Attribute geschlossen wird. Der Nominalessenz liegt nun die Realessenz zugrunde, und diese wird als die „Ursache“ der Akzidenzien betrachtet. Wir müssen also die Pflanzen zusammennehmen, welche die meisten Akzidenzien gemein haben, und das sind die, welche ähnliche Gestalt und Textur haben (*facies, habitus et textura*). Das Gesamtbild, etwa als Summe der Akzidenzien aufgefasst, steht im Vordergrund. Indessen bemerkt RAY, dass Blüte und Frucht gerade doch zur Einteilung angewandt werden können, weil diese sich bei den Pflanzen, die in den meisten Eigenschaften übereinstimmen, sehr konstant verhalten. Ein wichtiges Beispiel für dieses Verfahren bietet die Gruppe der Doldengewächse: das von RAY erstgenannte Merkmal ist die Dolde (*florum et seminum situs*); weiterhin aber stimmen alle diese Pflanzen durch die zusammengesetzten und zerstreut stehenden Blätter überein, und erst am Schluss erörtert RAY die Uebereinstimmung von Blüte und Frucht.

Wir lassen die weiteren Ueberlegungen RAYS unerörtert, weil sie für unsere Frage weniger wichtig sind. RAY selbst ist davon überzeugt, dass sein System, das sich indessen Zeit seines Lebens mehrmals geändert hat, viele Unvollkommenheiten hat; einerseits sind diese nach recht empiristischer Weise darauf zurückzuführen, dass die Natur sich nicht in einem System zwingen lässt: das wird durch die „anormalen“ Pflanzen gezeigt; andererseits aber ist RAY der Meinung, dass die kurze Lebensdauer und die Unzulänglichkeit des menschlichen Geistes es nicht gestatten, das natürliche (d.h. von der Natur gegebene) System zu erfassen. Durch all seine theoretischen Arbeiten geht, wie bei LOCKE, der Widerspruch, zu dem jeder empiristische Forscher, der an noch etwas anderes als an die Empirie glaubt, kommen muss.

V. Betrachtungen über einige modernen Theorien.

Es fragt sich ob in der modernen Systematik etwas ähnliches wie der Substanzbegriff zu finden sei. Wir weisen zunächst auf den dritten Abschnitt dieser Arbeit hin, wo schon einiges über die gegenwärtige Lage der Systematik erörtert worden ist. Die Situation ist jetzt derart,

dass die Grundfragen der Systematik sich nicht getrennt von den anderen Disziplinen der Botanik, wie Genetik, Deszendenztheorie, Phylogenie, Oekologie, Physiologie usw. untersuchen lassen. Ja, die Behandlung bestimmter Grundfragen wird sogar von einigen dieser Wissenschaften mehr in Anspruch genommen als von der Systematik selbst, z.B. die des Artproblems von der Genetik. Nun mag z.B. A. MEYER, der sich auf streng logischen Standpunkt stellt, behaupten, dass der systematische Artbegriff nicht identisch mit dem genetischen ist, für unsere Betrachtungen genügt — was A. MEYER auch zustimmt — dass beide in den meisten Erörterungen aufs engste verknüpft und öfters begrifflich ungetrennt vorkommen. Im Folgenden haben wir uns also nicht bloss der Systematik zuzuwenden, sondern auch der Genetik, usw. um zu wissen in wie weit substantielle Begriffe für die Systematik von Bedeutung geworden sind oder Bedeutung bekommen können. Dabei wird vielleicht die Systematik selbst etwas in den Hintergrund geraten, das ist aber nicht schlimm, da diese Fragen für die Prinzipien der Systematik von grosser Wichtigkeit sind. Wir wollen uns dabei so wenig wie nur möglich auf Diskussionen über den Artbegriff einlassen, obwohl das Problem in diesem Zusammenhang kaum gänzlich zu umgehen ist.

In Bezug auf den Substanzbegriff sind die grundlegenden Betrachtungen CASSIRERS in seinem „*Substanzbegriff und Funktionsbegriff*“ von ausserordentlicher Wichtigkeit. CASSIRER zeigt, dass das logische Verfahren in den Naturwissenschaften besonders was die Physik betrifft, sich im Wandel der Zeiten fundamental geändert hat. Die moderne Physik seit GALILEI bemüht sich nämlich sich von dem Substanzbegriff und der abstraktiven Klasseneinteilung los zu machen. Dabei ist wesentlich, dass der einzelne Fall, der in der Aristotelischen Physik in irgend einer Klasse untergebracht wurde, jetzt unter eine bestimmte Regel kommt. Laut, Licht, Elektrizität, z.B. früher als getrennte Klassen bestimmter Erscheinungen betrachtet, fallen jetzt unter denselben Schwingungsgesetzen. KEPLERS Gesetzen der Planetenbewegung und das Fallgesetz GALILEIS wurden von NEWTON unter dieselbe Regel, die der allgemeinen Gravitation gebracht. Diese allgemeinen Regeln lassen sich nicht durch Abstraktion gewinnen, sondern sie werden in deduktiver Weise hergeleitet, und nachher mit den Tatsachen verifiziert. Statt durch ein Abstraktionschema wird das Bild der Wirklichkeit durch ein Konstruktionschema, d.h. durch eine begriffliche Neuschöpfung (NATORP) aufgebaut. Wird durch Deduktion nun ein solches Konstruktionschema entworfen, so tritt das Reihenprinzip an die Stelle

des Klassenprinzips. Die Methode der Klasseneinteilung durch Abstraktion (= Abzug) der jedesmal akzidentellen (= unwesentlichen) Sachen führt schliesslich zu der Annahme einer Substanz. Dann bleibt nämlich die durch Abstraktion erhaltene substanzielle Identität als gemeinsamer Eigenschaftskomplex aller zu irgend einer Klasse gehörigen Individuen. Die (jedenfalls gedankliche) Konstruktion der Wirklichkeit ist aber nur möglich, wenn ein bestimmter Tatsachenbestand unter eine Regel gebracht wird, also als eine mathematische Funktion betrachtet wird. Auf diese Weise kommt CASSIRER zu seinem Reihenprinzip.

Das Beispiel einer mathematischen Reihe mag nun der Unterschied dieser beiden Methoden veranschaulichen. Nimmt man als gegeben die Reihe der Quadraten der natürlichen Zahlen, 1, 4, 9, 16, 25, 36, usw., so ergibt eine einfache Betrachtung dieser Reihe, dass die Differenzen der aufeinander folgenden Termini eine neue arithmetische Reihe bilden, nämlich die der unebenen Zahlen. Durch Abstraktion und Extrapolation kann man jetzt die folgenden Termini einfacherweise berechnen. Man kann aber in diesem Fall auch auf eine schlichte Weise durch Deduktion zur Konstruktion der Reihe gelangen. Denn es zeigt sich, dass der Unterschied zweier aufeinander folgender Termini in der Formel $(n+1)^2 - n^2 = 2n + 1$ ausgedrückt werden kann. Ohne diese Formel hätte man aber bei dem induktiven und abstraktiven Aufbau der Reihe keinen allgemein-gültigen Zusammenhang finden können.

In seinen glänzenden Untersuchungen über den Funktionsbegriff hat nun CASSIRER dargetan, dass in allen Gebieten der Naturwissenschaft eine Tendenz zur Elimination der substanziellen Begriffe zu finden ist. Freilich gilt das unbedingt für die Physik und Chemie, für die Biologie aber unserer Meinung nach nur in so weit hier die physikalisch-kausale Betrachtungsweise zur Anwendung kommt, d.h. in der Physiologie (im weitesten Sinne). Die Geschichte des Substanzbegriffes in der Philosophie gibt eine merkwürdige Parallele zu diesem Entwicklungsgang (vgl. z.B. RITTER) (29).

Es fragt sich ob diese Funktionsbegriffe auch irgendwo sonst in der Biologie angewandt werden können. Wir denken dabei zunächst an die Systematik und bemerken, dass vor allem die romantischen Systematiker (OKEN, FRIES, z.B.) im Anfang des 19. Jahrhunderts versucht haben zu konstruktiven Systemen zu gelangen¹⁾. Die Prinzipien dieser Systeme

1) Man vergleiche: *Systemata philosophica non ad naturae productuum individua, quae continuae varietati obnoxia, sed ad ideas aeternas et immutabiles*

führten zu einer Einteilung in eine beschränkte Anzahl Klassen, in welchen man sich die Merkmale immer als besondere Ausprägungen bestimmter Organeigenschaften vorstellte, nämlich ungefähr wie das Verhältnis einer mathematischen Funktion zu seinem Argument. Die Anzahl dieser Funktionen war beschränkt und dadurch war nur eine beschränkte Anzahl Arten möglich. Die Möglichkeit bestand irgend welche Lücken im System später auszufüllen und die wahrscheinliche Existenz bestimmter Formen vorauszusagen. Diese überaus künstlichen Systeme sollen hier aber nicht weiter besprochen werden: ihre Grundlage war allzu spekulativ, und ausserdem haben sie nicht zu wichtigen Ergebnissen geführt.

Weitaus wichtiger ist für uns die in neuerer Zeit von DRIESCH hervorgehobene Unterscheidung der rationellen Systematik. Diese muss, nach DRIESCH (10, S. 246—247), „auf einen Begriff begründet sein, mit dessen Hilfe eine Gesamtheit spezifischer Verscheidenheiten verständlich wird; d.h. jedes System, welches behauptet, rationell zu sein, muss uns einen Schlüssel geben, mittels dessen wir imstande sind zu begreifen: entweder, dass nur eine bestimmte Zahl von Artverschiedenheiten einer gewissen Gattung existieren kann, oder dass zwar eine unbegrenzte Zahl solcher Verschiedenheiten möglich ist, die aber einem bestimmten Gesetz mit Rücksicht auf die Natur ihrer Unterschiede folgen“. Gute Beispiele einer solchen rationellen Systematik finden sich in der Mathematik; Physik und Chemie sind so weit noch nicht, aber zeigen schon die Anfänge solcher Klassifikationen, z.B. das periodische System der Elemente und die homologen Reihen von organischen Verbindungen der Chemie. Es leuchtet ein, dass diese rationelle Systematik als Grundlage das Reihenprinzip (Funktionsbegriff) CASSIRERS hat. Jeder Terminus steht in funktionellem Zusammenhang mit den Anfangstermini der Reihe. Die Termini selbst haben keine substanziellen Eigenschaften, die ihnen einen wesentlichen Charakter verleihen, wie man es sich in der älteren Chemie (und Alchemie) dachte. Der wesentliche Charakter der Elemente ist durch ein quantitatives Bild ersetzt, das aber bei der Erwähnung einer Formel (= Zeichen) (z.B. Pb) nicht immer explizite ausgedrückt zu werden braucht. In einem solchen „periodischen“ System mit funktionellem Zusammenhang der Komponenten kann nicht

attendunt. Haec semper a centro egrediuntur ad peripheriam l. a perfectissimo ad inferiora — Cum mathematico convenit, seriem si invertas..... — Systema philosophicum ceteris antecellit. (FRIES, *Syst. Orb. Veg.* (12), p. 16—17).

nur die Möglichkeit des Bestehens bestimmter Elemente vorausgesagt werden, sondern ist es sogar möglich die wichtigsten Eigenschaften solcher Elemente im Voraus anzudeuten, wie z.B. die Geschichte der Entdeckung des *Germanium*s gezeigt hat.

Wir wollen nun wissen, in wie weit die neuen physikalischen und erkenntnistheoretischen Gedanken, wie sie von CASSIRER erörtert wurden, auf die moderne Biologie anwendbar sind. Es hat sich vielleicht nie eine fundamentalere „Umwertung der Werte“ in der Biologie ergeben als der wesentlich von DARWIN hervorgerufenen Deszendenzgedanke. Neben dem Prinzip, dass alle Organismen eine kontinue Reihe bilden, welche uns mehr oder weniger lückenhaft bekannt worden ist oder werden kann, steht als zweites, der nicht weniger wichtige Begriff der P a n g e n e s i s. Von DARWIN gegründet, von DE VRIES weitergeführt, hat dieser Begriff in der modernen Genetik durch die Schulen MORGANS und GOLDSCHMIDTS eine ausserordentlich hervorragende Bedeutung erhalten. Beide Teile dieser Theorie, Deszendenz und Pangenesis, stehen in ziemlich enger Beziehung zu einander und zur Systematik. Aber speziell die Pangenesis ist für unsere Betrachtungen von grösster Bedeutung. Durch diesen Begriff wird die Auffassung der „Merkmale“ fundamental geändert. Unter Pangenesis ist nämlich zu verstehen, dass jede besondere Ausprägung eines Merkmals zustande kommt unter Wirkung eines oder mehreren Pangene oder Gene¹⁾. Wie verschieden die Auffassung von der Art und Wirkungsweise der Gene bei den Autoren auch sein mag, man denkt sie doch meistens als stoffliche Agenzien²⁾, welche durch ihre Wirkung eine bestimmte Farbe, Behaarung, oder irgend ein anderes „Merkmal“ hervorrufen. Nicht bloss das Merkmal sondern auch der ganze Organismus wird hierdurch anders aufgefasst. Die Theorie der Pangenesis öffnet die Möglichkeit zu einer physiologischen (d.h. in Wesen physikalischen) Auffassung der Vererbung und der Formwerdung

1) Ueber die methodische Notwendigkeit einer Annahme solcher „Proto-bionten“ vergleiche man N. HARTMANN (15, S. 76 ff.).

2) Der Begriff der Pangenesis ist vielleicht schon bei RAY angedeutet, indem er sagt: sequitur, species hasce a se invicem essentialiter distingui, et intransmutabiles esse, earumque formas sive essentias, vel principia quaedam sui generis esse, hoc est particulas quasdam minimas materiae, ab omnibus aliis distinctas et naturaliter indivisibiles, vel λόγους quosdam σπειρματικούς idoneo sui generis vehiculo inclusos (*Diss. nova, Praef.*). Man muss sich aber davor hüten RAY auf allzu moderne Weise interpretieren zu wollen!

des Organismus. Die Analyse des Organismus (ebenso wie die eines physikalischen Prozesses) lässt die theoretische Rekonstruktion des Organismus aus den in dieser Weise festgestellten Elementarprozessen zu. Die von GOLDSCHMIDT z.B. ausgeführte Analyse der Intersexualität führt ihn (ob zwingend, lassen wir hier dahingestellt sein) zu der Annahme enzymatischer Prozesse, wodurch eine physiologische Theorie zu Stande kommt. In einer solchen Theorie kann man gewisse physiologische Prozesse durch rein chemisch-physikalische ersetzt denken, wodurch man sich dem von CASSIRER angeführten „Konstruktionsprinzip“ nähert. Wie ein bestimmter physikalischer Prozess, ausgehend von Atomen, Molekulan und ihren Eigenschaften synthetisch konstruiert werden kann, so soll nach dieser Auffassung auch der Organismus letzten Endes (wenigstens prinzipiell) in einem schematischen Bilde konstruiert werden können¹⁾.

Es fragt sich — und das ist (wie PLATE hervorhebt) teils auch die alte Frage der Evolution oder Epigenesis — ob das Entstehen des ganzen Organismus durch die Arbeit dieser Gene gedacht werden muss. Und weiter, in wie weit diese Gene sich nach mendelistischer Art austauschen lassen. Es ist bekannt, dass wir von etwaigen „Gene“, die nicht nach mendelistischer Art spalten, gar wenig wissen, vielleicht auch weil der Begriff „Gen“ in diesem Fall nicht recht deutlich feststellbar ist. Die ursprünglich von DE VRIES in seiner *Intracellulare Pangenesis* vertretene Theorie besagt, dass der ganze Organismus durch die Arbeit solcher P angene zustande kommt. Späterhin hat man die Definition der Gene in soweit umgeändert, dass man auf das Bestehen bestimmter Gene nur noch nach einer erfolgreichen Mendelanalyse schliesst. Es ist nun eins der Ergebnisse der modernen Genetik, dass sie dargetan hat, dass nicht alle Eigenschaften oder Merkmale eines organischen Körpers in dieser Weise zu analysieren und auf Genwirkung zurückzuführen sind. — Einige der Theorien, die sich hiermit beschäftigen, wollen wir einer kurzen Besprechung unterwerfen. Wir wenden uns zuerst

1) Es soll darauf hingewiesen sein, dass es hier nicht um tatsächlichen synthetischen Aufbau der Lebewesen handelt. Gerade NEWTONS astronomisches Weltbild ist ein gutes Beispiel der mathematisch-physikalischen Konstruktion. Es ist bloss „gedanklich“ konstruiert. Denn obwohl in der Astronomie dieser Konstruktionsbegriff einwandfrei berechtigt ist, wird wohl niemand daran denken, dass es einst möglich sein wird sich ein ähnliches Sonnensystem wie das der Astronomie synthetisch aufzubauen. Die Frage nach der Möglichkeit eines tatsächlichen synthetischen Aufbaus der Organismen ist vielleicht wohl unauflöslich.

VAVILOVS Theorie der homologen Reihen zu, weil diese eine eigentümliche Zwischenstellung einnimmt, und in ihrer ursprünglichen Form ein abstraktives Klassifikationsverfahren aufweist.

Einer der wichtigsten modernen Versuche um zu einer rationellen Klassifikation zu geraten, ist diese Theorie der „homologen Reihen der Variation“. Sie besagt kurz, dass „Linneonten und Genera aus einer grossen Menge variabler Unterschiede zusammengesetzt sind“, und dass diese Variabilität in nah verwandten Linneonten und Gattungen mehr oder weniger dieselbe ist. Hat man z.B. für eine Spezies (Linneon) A, variierende Merkmale an den Organen a, b, c, d, usw., so kann man in einer verwandten Spezies B gleichartige Variationen an den selben Organen erwarten. Eine Bestätigung findet die Theorie u. m. darin, dass es auf diese Weise gelungen ist, durch Analogieschlüsse unbekannte Varietäten, oder sogar Spezies vorauszusagen. Später wurden diese dann auch wirklich entdeckt. Nun ist es klar — wie VAVILOV selbst ausführt —, dass diese variierenden Eigenschaften (Merkmale) von keiner Bedeutung sind bei der Unterscheidung der Linneonten. Diese lassen sich nur unterscheiden durch „spezifische Komplexe morphologischer oder physiologischer Natur“, s.g. *Radikale*. So gibt es Radikale für Linneonten, andere für Gattungen, für Familien usw. Ueber die Natur dieser Radikale lässt VAVILOV sich nicht aus, er meint, dass sie von spezieller genetischer Natur sein könnten, aber dass unsere Kenntnis in dieser Beziehung noch zu gering sei. Die Systematik und Abgrenzung der Arten und Gattungen soll sich nun durch die Radikale ergeben. Vielfach lassen diese sich nur durch „Intuition“ feststellen. In manchen Fällen sind untaugliche Unterscheidungen zustande gekommen, indem man variierende Merkmalkomplexe mit den Radikalen vermischte.

Es ist möglich mittels dieses Begriffes des Radikals zu einer symbolischen Vorstellung der Gattungen, Spezies und Varietäten zu kommen. Wenn G_1, G_2, G_3 , usw. die Radikale einiger Gattungen, L_1, L_2, L_3 , usw. die Radikale einiger Spezies, und a, b, c, usw. variierende Merkmale der zu diesen Arten gehörigen Varietäten sind, so liessen sich die Spezies (Linneonten) unter der Formel $GL(a + b + c + d \dots)$ fassen, und so liesse eine bestimmte Varietät sich durch $G_1L_1(a_1b_1c_1\dots)$, eine andere Varietät derselben Spezies durch $G_1L_1(a_2b_2c_1\dots)$, eine „homologe“ Varietät einer Verwandten Spezies durch $G_1L_2(a_2b_2c_1\dots)$ vorstellen, usw.

Diese Radikale sind in vielerlei Hinsicht mit den Aristotelischen Substanzen zu vergleichen. Erstens stimmen die variablen Eigenschaften

(resp. Merkmale) a, b, c, usw. ganz und gar mit den akzidentellen Kategorien überein. Denn ob in einem bestimmten Individuum das Merkmal a rot ist, oder blau, oder gelb oder grün, ist einerlei: dennoch gehört das Individuum z.B. zu der Spezies *Triticum vulgare*, und das Radikal ist es, das dieses Individuum zur Spezies gehörig bestimmt. Fragt man, was es ist, das dieses Individuum zu dem macht, was es ist, so ist die Antwort: das Radikal. Und dies ist eben die Substanz (im Sinne der Essenz). Aber: in dem Radikal der Spezies muss auch das der Gattung mit einbegriffen sein, und weiter das der Familie, usw. Also: von dem Individuum wird die Spezies ausgesagt, von dieser wieder die Gattung, und von dieser wieder die höhere Gattung usw. Es berührt einen, als ob man hier ARISTOTELES selbst oder PORPHYRIUS reden hört. Man bedenke dabei, dass das Radikal VAVILOVS nicht *ὑποκείμενον* (Substrat) ist.

Das Radikal VAVILOVS ist eine typische Aristotelische Abstraktion. Obwohl es das „Wesen“ eines Organismus als seiner Klassenzugehörigkeit andeutet, ist es dennoch kein ontologischer Begriff. Die Radikale sind Merkmalkomplexe, die nur *phänomenal* zu erfassen sind. Und die Frage nach dem „Was“ des Radikals ist wohl nicht ganz unauflöslich (wenigstens prinzipiell). VAVILOV äussert sich gar nicht über die Natur seiner Radikale. Aber für den modernen Naturwissenschaftler ist es kein „letztes“ Wesen. Man wird versuchen es in weitere Gründe zu zerlegen, und als solche wird man zunächst an irgendein physikalisch-chemisches System denken. Aber jetzt ist man noch nicht so weit diesen Begriff in Elementarerbegriffe auflösen zu können. Deshalb sagt das Radikal VAVILOVS in seiner heutigen Form nur wenig aus; es ist aber ein vorzüglicher systematischer Begriff. Und gerade aus der Tatsache, dass es ein logischer Begriff ist, ergibt sich die treffende Uebereinstimmung mit der Aristotelischen zweiten Substanz.

Das Gesetz VAVILOVS kann, obwohl es selbst wesentlich „systematisch“ (d.h. Aristotelisch) ist, vielleicht doch zu einer funktionellen Deutung bestimmter systematischer Probleme hinüberführen. Wiewohl hier die homologen Reihen empirisch-induktiv gewonnen sind, gibt eben die Existenz dieser Reihen den ersten Ansatz zu einer funktionellen Auffassung, die aber zur Zeit noch nicht rationell auszusagen ist. Ein wichtiger Fortschritt in dieser Richtung wurde von PHILIPTSCHENKO erreicht, indem er innerhalb des der Chemie entlehnten Begriffes der „homologen“ Reihen VAVILOVS, den genotypischen, oekotypischen und morphologischen Parallelismus unterscheidet. Die beiden ersten Paral-

lelismen sind der genetischen ¹⁾ Analyse (wenigstens prinzipiell) zugänglich, und vielleicht wird es auf dieser Grundlage möglich VAVILOVS „Gesetz“ zu einem allgemeinen „Grundgesetz der gruppenweise Variation“ ²⁾ zu erheben. Das Gesetz VAVILOVS in ursprünglicher Form besagt nur irgendeine Regelmässigkeit der Variabilität und ist als solches eben nur ein Klassifikationsprinzip.

Wie schon am Anfang dieses Abschnitts bemerkt wurde, hat DRIESCH den Begriff der rationellen Systematik eingeführt. Wir wollen jetzt kurz nachgehen in welcher Weise DRIESCH sich etwa vorstellt, dass die Biologie zu einer solchen rationellen Klassifikation gelangen kann. In dieser Hinsicht ist er sehr vorsichtig, indem er sagt zu „glauben“, dass das unbekannte transformistische Prinzip mit der Entelechie selbst verknüpft sei: „Die Systematik der Organismen würde alsdann eigentlich eine Systematik der Entelechien sein, und eben darum wären die organischen Formen „*formae essentiales*“, die Entelechie wäre die eigentlichen Essenz der Form in ihrer Spezifität. Das System würde in diesem Falle natürlich einen wahrhaft rationellen Charakter in Zukunft annehmen können: eines Tages könnte ein Prinzip aufgefunden werden, das von der Totalität der möglichen Formen Rechenschaft gibt, ein Prinzip basiert auf der Analyse der Entelechie“ (10, S. 287). DRIESCH sagt also selber, dass wir jetzt noch nicht so weit sind. Seiner Meinung nach ist die biologische Systematik zur Zeit noch nicht weiter gelangt als eine blosse katalogisierende Klassifikation. Es ist aber gerade diese Klassifikation, die eine typisch Aristotelische Begriffsbildung hat und die sich nur zögernd dem modernen Funktionsbegriff offenstellt. Ob sich in einem rationellen System die Entelechie in der von DRIESCH aufgefassten Form handhaben könne, lässt sich hier nicht angeben. Es scheint aber, dass mit der Einführung solcher rationellen Prinzipien eben der Charakter der Entelechie angegriffen wird. Und damit würde, unserer Meinung nach, vom vitalistischen Standpunkte DRIESCHS die Möglichkeit einer rationellen Systematik für die Biologie in Frage gestellt werden.

Wir möchten an dieser Stelle noch PLATES Erbstockhypothese anführen. PLATE formuliert sie in dieser Weise: „Man muss daher annehmen, dass das Keimplasma einer Art sich zusammensetzt aus einem

1) Man bedenke das Genetik = Physiologie = Kausalforschung ist.

2) PHILIPTSCHENKO unterscheidet: Variabilität (Veränderlichkeit als Zustand = statisch) und Variation (Veränderlichkeit als Prozess = dynamisch).

nur schwer veränderlichen „Erbstock“ und den mendelnden Genen. Der Erbstock ruft alle wichtigsten Organe hervor, deren äussere Einzelheiten von Erbfaktoren nach den Mendelschen Gesetzen bestimmt werden“ (21, S. 99—100). PLATES Erbstockhypothese besagt im grossen ganzen nichts anders als ein Unterschied in der Vererbung der Organe und der ihrer Merkmale. Prinzipiell ist diese Unterscheidung nach der Auffassung PLATES selbst indessen nicht. Die Theorie ist aus phylogenetischen Ueberlegungen hervorgegangen und hat dann auch wichtigere Ansätze zur Phylogenie als zur Systematik. PLATE ist der Meinung, dass Organe bei ihrem ersten Auftreten in Bezug auf die Vererbung mit mendelnden Eigenschaften gleichzustellen sind. Allmählich wird der Erbgang komplizierter, indem immer mehr Gene an der Ausbildung des Organs teilnehmen. Endlich bildet sich ein mehr oder weniger fester Genenkomplex (Radikal), das sich dann aus den Chromosomen ausscheidet und sich dem Erbstock anschliesst. Zuletzt wird die Vererbung des Organs vom Erbstock verursacht, die Vererbung seiner Eigenschaften (Merkmale) von den in den Chromosomen gelagerten Genen. Hier macht PLATE (wie fast alle Lamarckisten) ein gewisser Gegensatz zwischen den „beginnenden“ und den phylogenetisch völlig ausgebildeten Organe. Beginnende Organe und Ausprägungen (Merkmale) der älteren Organe vererben sich nach mendelistischer Weise, d.h. es besteht die Möglichkeit, dass sie phänotypisch abwesend sind. Daraus ergibt sich, dass sie nicht in irgendeiner Weise für die wesentliche Bestimmung des Organismus wichtig sind. Diese kann daher nur vom Erbstock ausgehen. Die Systematik hat hier nichts mit der „nur schweren“ Veränderlichkeit des Erbstocks zu tun, sondern an erster Stelle mit den Verschiedenheiten in den Erbstöcken verschiedener Organismen. In gewissem Sinn kann ein Organ für die Systematik erst dann grössere Bedeutung bekommen, wenn sein Träger in den Erbstock aufgenommen ist, wenn er also eine gewisse Beharrlichkeit bekommen hat, d.h. wenn er sich dem Bauplan angeschlossen hat. Der etwas rätselhafte Erbstock kommt als Summe bestimmter Genkomplexe zustande. Ob dies nur eine Summe ist, oder ob etwa ein „Ganzheitsfaktor“ (Gestaltqualität) hinzutritt, lässt PLATE unerörtert. Im grossen ganzen ist die ganze Theorie noch nicht mehr als eine auf spekulativem Wege gewonnene phylogenetische Hypothese. ~ •

Wir wollen es bei diesen kritischen Bemerkungen bewenden lassen. Für unsere Betrachtungen ist wesentlich, dass ein Teil der Eigenschaften der genetischen Analyse zugänglich und ein anderer Teil ihr nicht

zugänglich ist. Letzterer ist freilich noch gar keiner Analyse zugänglich. Phylogenetische Erwägungen lassen wir hier dahingestellt sein. Die ganze Hypothese besagt nichts anderes als eine Pangenesis, in welcher aber nur ein Teil der Pangene durch Analyse bekannt gemacht werden kann. Der genetisch analysierbare Teil der Eigenschaften ist nur der, der für die Speziesunterscheidung am wenigsten wichtig ist. Mit anderen Worten: die Speziesunterscheidung kann nur durch die von dem „Erbstock“ hervorgerufenen Eigenschaften ausgeführt werden. Das hat PLATE wahrscheinlich nicht in so scharfer Form aussagen wollen, aber wir werden zu dieser Formulierung durch die Tatsache geführt, dass die mendelnden Merkmale nur Varietätsmerkmale sind.

Obwohl der Erbstock logisch nicht ohne weiteres als Substanz zu bezeichnen ist, meinen wir, dass in der Aufstellung derartiger Theorien sich psychologisch das Bedürfnis nach einer substantiellen Form offenbart. Und von diesem Gesichtspunkt aus stehen die Theorien PLATES und VAVILOVS mit den noch zu erwähnenden F. W. WENTS und WOLTERECKS auf einer Höhe. Zur Speziesbestimmung, bzw. phylogenetischen Untersuchungen muss man einerseits die Akzidenzien lösen; es bleibt aber dann noch Etwas, das als Substrat die Akzidenzien trägt, bzw. verwirklicht. Aber andererseits will man das „Wesentliche“ als das, was die Klassenzugehörigkeit bestimmt, kennen. Ist diese Substanz nun rein abstraktiv erhalten, wie bei VAVILOV, oder aber mittels Ueberlegungen phylogenetischer oder physiologischer Art, wie bei PLATE, bzw. WENT, solange das von der Physiologie verheissene Konstruktionschema nicht verwirklicht ist, sind nur solche substantiellen Formen zur Klassifikation anwendbar.

In ihrer Annahme, dass der „Erbstock“ prinzipiell nicht von dem „Mendelstock“ verschieden ist, steht nun die Theorie PLATES denen anderer moderner Forscher gegenüber. Gemeinsam ist allen hier erwähnten Theorien, dass sie mendelnde und nicht-mendelnde Eigenschaften unterscheiden, von denen letztere eine gewisse Diskontinuität hervorrufen, durch die sie zur Speziesunterscheidung geeignet sind.

F. W. WENT (37) hat neuerdings eine physiologische Theorie projiziert, die zwar in Einzelheiten nicht direkt einwandfrei erscheint, aber doch für unsere Betrachtungen wichtige Elemente enthält. Die Theorie ist eine Erweiterung eines von CORRENS (1901) geäusserten Satzes, dass die erblichen Faktoren des Kernes durch Mithilfe des Protoplasmas zur Entfaltung kommen können. WENT nimmt nun eine stoffliche Lokalisation der erblichen Eigenschaften in den Chromosomen an. Die Akti-

vierung dieser Eigenschaften vollzieht sich in einer bestimmten Reihenfolge. Er betrachtet sie als von „Nebenstoffen“ bewirkt, die nach einander mit einer „Grundsubstanz“¹⁾, die er ins Protoplasma hineinlegt, reagieren. Durch diese Reaktionen ändert sich das Protoplasma immer und sollen die nacheinanderfolgenden Stadien einen verschiedenen formgebenden Wert haben. Die in den Chromosomen lokalisierten Nebenstoffe sollten etwa die mendelnden Eigenschaften hervorrufen, die „Grundsubstanz“ (an sich, oder durch die Einwirkung bestimmter entwicklungsanregender Nebenstoffe?) den Bauplan. Die Nebenstoffe haben an sich keine Bedeutung, nur in Verbindung mit der „Grundsubstanz“ wird ihre Wirkung manifestiert. Die Gene (Nebenstoffe) sind unserer Forschung zugänglich, die „Grundsubstanz“ bleibt aber dieselbe²⁾ und entzieht sich der jetzigen genetischen Analyse. In dieser „Grundsubstanz“ sind also wichtige substanzielle Eigenschaften gegeben: einerseits die spezifische Eigentümlichkeit, die Beharrlichkeit, andererseits aber auch die Eigenschaften des Substrats, an dem die Akzidenzien verbunden sind.

WOLTERECK (39) endlich weist nochmals hin auf den Gegensatz zwischen den festen, beharrlichen, spezifischen Eigenschaften und die Eigenschaften akzessorischer Art. Wie alle anderen hier angeführten Forscher denkt er sich die letzteren in den Chromosomen lokalisiert. Für die spezifischen Eigenschaften nimmt er eine „Artsubstanz“³⁾ an, die seiner Meinung nach „kaum hypothetisch“ ist. „Die lebende, in allen Zellen eines Organismus spezifische Zell- und Kernsubstanz kann als Tatsache betrachtet werden. Aber sie ist eine komplexe Grösse und als solche für die Analyse untauglich“ (39, S. 298).

Alle diese Betrachtungen zeigen, dass die jetzige Forschung noch keine Antwort auf die Frage nach der Natur der Spezifität geben kann.

Als wichtig ergibt sich, dass die physikalische Auffassung der Organismen für die gegenwärtige Systematik noch nicht anwendbar ist. Bei der Analyse bleibt eben ein unzugänglicher Restbestand zurück, mit welchem man gerade die spezifischen Eigenschaften verknüpft denken

1) Das Wort „Grundsubstanz“ soll hier ganz in dem von WENT beabsichtigten Sinn, d. h. ohne irgendwelche Beziehung zum Aristotelischen Terminus genommen werden. Wir wagen es aber nicht, den Terminus WENTS etwa mit „Grundstoff“ zu übersetzen.

2) Sie ändert offenbar nur ihre Beschaffenheit (*quodditas*), nicht ihre wesentlichen Eigenschaften (*quidditas*).

3) Unter Substanz wird hier „Stoff“, nämlich „Artplasma“ verstanden.

muss. Von einigen Forschern wird diesem Rest, als Sitz der „Essenz“, noch ausserdem die Eigenschaften des Substrats, als Träger der Akzidenzien, zuerkannt. Weder phylogenetische noch physiologische Methoden haben diesen Rest schon angreifen können. Die Pangenesis hat also wohl zu einer Kritik, nicht aber zur Ueberwindung des Substanzbegriffes geführt. Und dadurch ist eben eine physikalische Auffassung der Organismen nach dem Reihenprinzip zurzeit nicht möglich. Bemerkt man uns gegenüber, dass sie aber doch in Prinzip gegeben ist, so erwidern wir: sie ist zurzeit noch eben nicht einigermassen exakt formulierbar. Es ist gerade dieser Restbestand, der der Analyse in dem Wege steht. Fragt man, was gerade das ist, was die spezifische Beschaffenheit der Pflanzen trägt, so kann man nur antworten, dass es das „eigentümliche Sein“ ($\tauὸ \tauὶ ἥν εἶναι$ ¹⁾ = $\epsilonἶδος$ ²⁾) ist. Das ist eine Antwort im Sinne der Aristotelischen Begriffsbildung. Der moderne Naturwissenschaftler kann aber bei einer derartigen Antwort nicht stehen bleiben! Seine Analyse hört erst bei den letzten Atomen und Energien auf. In wie weit, und ob, es nun in der — vielleicht sehr fernen — Zukunft möglich sein wird, diesen wahrscheinlich letzten Aristotelischen Begriff der Naturwissenschaft zu beseitigen, können wir nicht voraussagen.

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1) „Ein unverwüstlicher Unbegriff“ (FREYTAG (11), S. 4).

2) Bei ARISTOTELES auch etwa = Artbegriff!

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**ARTIFICIAL KEY TO THE ORCHID GENERA OF
THE NETHERLANDS INDIES, TOGETHER WITH THOSE OF
NEW GUINEA, THE MALAY PENINSULA AND
THE PHILIPPINES**

by

J. J. SMITH

(Oegstgeest).

It is often a very difficult task for the many amateurs and cultivators of Orchids, and I may add hardly in a less degree to students of the flora of the Netherlands Indies, to classify properly the Orchids they come across. The reason for this lies not only in the fact that the generic characters in this large order are often not easily distinguished, but also in the fact that nearly every genus counts a certain number of more or less anomalous species, so that the limits between the genera are not always easy to determine. Besides, many descriptions are, even in principal points, incomplete, either because the authors had no sufficiently good material at their disposal, or because they did not take the trouble to draw up good descriptions. For these reasons species are unavoidably often placed into a wrong genus, to which fact a great deal of the prevailing confusion is to be ascribed.

Although in the course of years many questions have been solved, it cannot be denied that new problems did arise. Only very accurate and complete descriptions, the best, of course, elucidated by figures after fresh or alcohol material, can put us in a position to decrease these difficulties.

In order to meet at least in some way the wishes of many, I have tried to make a key to the genera of *Orchidaceae* occurring in the Netherlands Indies. It is far from me to think, that I have solved with this the difficulties, alone already for the reason that I am not acquainted with some of these genera by my own study so that I have to rely in such cases upon often incomplete data, and even because the limitation of genera which I know from personal experience in some cases have not yet become quite clear to me.

It is hardly necessary to state that this key does not claim the least scientific value; it is intended only as an effort to open in some degree a way to those who want to arrange the Orchid species in the right genera. Although it is meant only for the genera of the Netherlands Indies I have included those of New Guinea, the Malay Peninsula and the Philippines.

- | | |
|--|--------------------------------|
| 1. Two or three fertile anthers; three fertile stigmata | 2 |
| One fertile anther; two fertile stigmata, the third transformed into a rostellum | 4 |
| 2. Lip saccate or shoe-shaped; staminode large, disklike; anthers globose | Paphiopedilum PFITZ. |
| Lip not saccate; staminode 0 or filiform; anthers elongate, not globose | 3 |
| 3. Three fertile stamens | Neuwiedia BL. |
| Two fertile stamens | Apostasia BL. |
| 4. Saprophytes | 5 |
| No saprophytes; leaves sometimes reduced to scales | 19 |
| 5. Anther inserted with a broad base; pollinia with caudicles towards the base of the anther | 6 |
| Pollinia without or with appendages towards the top of the anther | 7 |
| 6. Lip entire, spurred; flowers pale ... | Platanthera L. C. RICH. |
| Lip 3-lobed, not spurred; flowers coloured | Silvorchis J. J. S. |
| 7. Lip with 2 bubbles or 2 spurs at the base | 8 |
| Lip without bubbles, without or with 1 spur | 9 |
| 8. Lip with two bubbles at the base; flowers in a spike | Cystorchis BL. |
| Lip with 2 spurs; flowers large, solitary ... | Corybas SALISB. |
| 9. Stems more or less climbing, rooting; inflorescence much ramified | Galeola LOUR. |
| Stems (not the rhizome) not climbing, not rooting | 10 |
| 10. Pollinia 8; flower with green markings on the lip | Pachystoma BL. |
| Pollinia less than 8 | 11 |
| 11. Sepals and petals connate | 12 |
| Sepals and petals free | 13 |
| 12. Stigma below the top of the column | Didymoplexis GRIFF. |
| Stigma at the base of the column | Gastrodia R. BR. |

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|-----|---|--------------------------------|----|
| 13. | Flowers at the base with a toothed cup.... | Lecanorchis BL. | |
| | Flowers without a toothed cup at the base | | 14 |
| 14. | Lip with a usually short spur | | 15 |
| | Lip without a spur | | 16 |
| 15. | Inflorescence nodding at the top; flowers pale (a spurless form not rarely occurs) | Epipogum GMEL. | |
| | Inflorescence not nodding, tinged with green; spur short; flowers coloured | Eulophia R. BR. | |
| 16. | Ovary abruptly contracted in the much thinner pedicel ... | Stereosandra BL. | |
| | Ovary not abruptly contracted in the pedicel | | 17 |
| 17. | Lip with a distinct, bilobed hypophile | Aphyllorchis BL. | |
| | Lip without such like hypophile | | 18 |
| 18. | Peduncle, roots and fruits thick; pollinia without a stipes ... | Galeola LOUR. | |
| | Peduncle thin; pollinia on a thin stipes | Tropidia BL. | |
| 19. | Anther inserted with a broad base, immobile; pollinia with caudicles towards the base of the anther | | 20 |
| | Pollinia without or with appendages towards the top of the anther | | 25 |
| 20. | Fertile stigmata flat or concave, confluent, at best separated by a furrow | | 21 |
| | Stigmata separated, not flat | | 23 |
| 21. | Lip spurred | Platanthera L. C. RICH. | |
| | Lip not spurred | | 22 |
| 22. | Leafy plants, flowers green; lip entire | Herminium L. | |
| | Saprophyte; flowers coloured; lip threelobed | Silvorchis J. J. S. | |
| 23. | Small plant with one sessile leaf and a few-flowered inflorescence; lip not spurred | Disperis SW. | |
| | Larger plants; leaves more than one; lip spurred | | 24 |
| 24. | Claw of the lip adnate to the borders of the column and of the stigmata | Peristylus BL. | |
| | Stigmata free, on two shorter or longer processes | Habenaria WILLD. | |
| 25. | Leaves reduced to scales | | 26 |
| | Normal leaves present, though sometimes very small | | 30 |
| 26. | Stem elongate, climbing, rooting, green; flowers large, in few-flowered racemes | Vanilla SW. | |

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|-----|---|----|
| 39. | No pseudobulbs; stems elongate, climbing, rooting | 40 |
| | Stems not climbing, whether or not ramified, without aerial roots (sometimes rhizome climbing) | 41 |
| 40. | Inflorescence a short, (apparently) lateral raceme; lip adnate to the column rather over a long distance Vanilla Sw. | |
| | Flowers in terminal panicles; lip very shortly or indistinctly adnate to the column Galeola Bl. | |
| 41. | Young leaf convolutive, the margins overlapping one another 42 | |
| | Young leaf duplicative, with the margins not overlapping; to this series belong also the terete and laterally compressed leaves 80 | |
| 42. | Terrestrial orchids with fascicled, fleshy roots; leaves radical, narrow; flowers small, second or spirally arranged | |
| | Spiranthes L. C. RICH. | |
| | Otherwise 43 | |
| 43. | No real sympodium, stems after flowering emitting one or a few side branches near the inflorescence between the leaves; pollinia sectile 44 | |
| | Rhizome covered with scales or sheaths without a blade; pollinia not sectile 67 | |
| 44. | Stigmata 2, separate 45 | |
| | Stigma 1 53 | |
| 45. | Lip inside with hairlike appendages (perhaps a monstrous form of Goodyera) Eucosia Bl. | |
| | Lip without hairlike appendages within 46 | |
| 46. | Sepals and petals connate Cheirostylis Bl. | |
| | Sepals and petals free 47 | |
| 47. | Spur of the lip projecting between the lateral sepals 48 | |
| | Base of the lip concealed by the lateral sepals 49 | |
| 48. | Spur inside with 2 distinctly stipitate glands; margins of the lip not laciniate Vrydagzynea Bl. | |
| | Spur inside with 2 sessile glands; margins of the lip laciniate Anoectochilus Bl. | |
| 49. | Claw of lip on both sides laciniate Odontochilus Bl. | |
| | Claw of lip entire or wanting 50 | |
| 50. | Blade of lip long clawed; flowers pure white Myrmechis Bl. | |
| | Blade of lip without or with a short claw 51 | |
| 51. | Column recurved; lip in the anterior part tubular and papillose Tubilabium J. J. S. | |

- Column not recurved; lip otherwise 52
52. Lip turned downward; stipes of the pollinia broad; laciniae of the rostellum large **Zeuxine** LNDL.
Lip turned upward, or more or less oblique; stipes of the pollinia narrow; laciniae of the rostellum small **Hetaeria** BL.
53. Lip and column twisted 54
Lip and column not twisted; lip sometimes turned upward 55
54. Lip blade slightly broadened; column with two longitudinal lamellae in front **Macodes** BL.
Blade of lip strongly broadened; column without lamellae in front **Haemaria** LNDL.
55. Lip turned upward **Papuaea** SCHLTR.
Lip turned downward 56
56. Lip without appendages at the base within 57
Lip with glands, warts, lamellae or hairlike appendages at the base within 60
57. Spur long, bilobed at the top 58
Spur short, wide, not bilobed 59
58. Lip with 2 longitudinal thickenings on the blade
Herpysma LNDL.
Lip without thickenings **Erythroides** BL.
59. Column with 2 subulate teeth near the stigma
Dicerostylis BL.
Column without teeth near the stigma ... **Hylophila** LNDL.
60. The ventricose part of the lip inside covered all over with or provided at the base only with 2 tufts of hairlike appendages 61
Lip without hairlike appendages, but inside at the base with glands or warts 63
61. Ventricose part of lip inside allover covered with hairlike appendages **Goodyera** R. BR.
Lip inside at the base with 2 tufts of hairlike appendages ... 62
62. Lip at the base adnate to the column, with a short, dorsally compressed spur, 3-lobed, with the midlobe clawed
Orchipedum BREDA
Lip not spurred, very concave, constricted on both sides above the base; blade sessile **Platylepis** BL.
63. Lip inside with a transverse row of warts; big plants with a thick stem and linear leaves **Lepidogyne** BL.

- Lip inside at the base with 2 glands or warts 64
64. Blade of lip with a long, pectinate or crenate claw
 Pristiglottis CRETZ. et J. J. S. (**Cystopus** BL.)
- Blade of lip not clawed or claw entire 65
65. Spur of lip distinctly projecting between the lateral sepals
 Eurycentrum SCHLTR.
- Spur short, entirely or nearly entirely concealed by the
 lateral sepals 66
66. Column with 2 longitudinal lamellae in front **Dossinia** MORR.
 Column without lamellae **Kuhlhasseltia** J. J. S.
67. No pseudobulbs; stems more-leaved 68
 Pseudobulbs 1—2-leaved 71
68. Stems short, remote on the rhizome, c. 4-leaved; pollinia 4
 Claderia Hook. f.
- Stems approximate 69
69. Lip entire; pollinia 2 **Tropidia** BL.
 Lip 3-lobed; pollinia 8 70
70. Petals broader than the sepals; fruit elongate **Arundina** BL.
 Petals not broader than the sepals; fruit globose
 Dilochia LNDL.
71. Lip adnate to the column **Gynoglottis** J. J. S.
 Lip free 72
72. Lateral sepals connate at the base and forming a two-lobed
 mentum, narrowly enclosing the 2-lobed sac of the lip
 Bracisepalum J. J. S.
- Mentum not bilobed, not narrowly enclosing the base of the
 lip 73
73. Column with one terminal and 2 lateral wings, which are
 distinctly separate, the latter sometimes very small, rarely
 wanting **Dendrochilum** BL.
- Column often winged at the top, without lateral wings ... 74
74. Lip entire, strongly sigmoid **Sigmatochilus** ROLFE
 Lip otherwise 75
75. Lip distinctly saccate at the base 76
 Lip more or less concave at the base (saccate in a few species
 of *Coclogyne*) 78
76. Column not or slightly winged, or broadly winged along
 nearly the whole length 77
 Column winged at the top only **Nabaluia** AMES.

77.	Blade of lip nearly entire or if 3-lobed with a sessile midlobe	Pholidota LNDL.	
	Blade of lip 3-lobed; midlobe broadly clawed	Coelogyne LNDL. sect. Chelonistele .	
78.	Column not winged	Acoridium NEES.	
	Column slightly to strongly winged		79
79.	Column slender; petals not abruptly clawed; flowers often large	Coelogyne LNDL.	
	Column short; petals abruptly clawed	Basigyne J. J. S.	
80.	Pollinia 4 or 6, on one bifid or on 2 stipites which are each more or less spathulate at the top, inserted at the base of the broadened portion		81
	Otherwise		82
81.	Pollinia 4	Podochilus BL.	
	Pollinia 6	Appendicula BL.	
82.	Pollinia 2	Bromheadia LNDL.	
	Pollinia 4		83
	Pollinia 8		93
83.	Pollinia without gland and stipes		84
	Pollinia with a gland and/or stipes		88
84.	Column foot present; plants very multiform	Dendrobium Sw.	
	No column foot		85
85.	Leaves laterally compressed		86
	Leaves not laterally compressed, often apparently convolutive		87
86.	Column very short; stems usually crowded	Oberonia LNDL.	
	Column somewhat elongate; stems very or moderately remote	Hippeophyllum SCHLTR.	
87.	Column very short; flowers not resupinate, thus lip turned upward	Microstylis NUTT.	
	Column long or short; lip turned downward	Liparis L. C. RICH.	
88.	Lip without a sac or spur		89
	Lip with a sac or spur		91
89.	Inflorescence long peduncled, panicled... ..	Polystachya JUSS.	
	Inflorescence sessile, one- or few-flowered, fascicled		90
90.	Lip concave, sessile, entire; no column foot	Aglossorhyncha SCHLTR.	
	Lip clawed, 3-lobed; column foot present ...	Sarcostoma BL.	
91.	The strongly broadened base of the lateral sepals adnate to		

- the long spur of the lip into a long spurlike mentum (thus nearly like in many *Dendrobiums*..... **Sepalosiphon** SCHLTR.
Base of the lateral sepals not adnate to the spur of the lip into a long mentum 92
92. Lip at the base shortly adnate to the column **Glomera** BL.
Lip apparently not adnate to the column
Ischnocentrum SCHLTR.
93. Sepals connate, only free at the tops ... **Mediocalcar** J. J. S.
Sepals not connate 94
94. Stems more or less elongate, more-leaved; flowers in head-like, paniculate or spikelike, few- or many-flowered inflorescences; lip more or less saccate at the base, the cavity separated from the other part by a transverse lamella or thickening **Agrostophyllum** BL.
Sprouts one-leaved at the top; lip without a cavity separated by a transverse lamella at the base 95
95. Lip adnate at the base to the column foot by a longitudinal keel; column not divided in two arms... **Epiblastus** SCHLTR.
Lip not adnate to the column foot; column with arms or lobes containing the stigmata **Ceratostylis** BL.
96. Leaves convolutive 97
Leaves duplicative 113
97. Leafy stems elongate, climbing, rooting **Vanilla** Sw.
Stems not climbing and rooting, the rhizome sometimes... 98
98. Pollinia 2, often furrowed or split 99
Pollinia 4 105
Pollinia 8 107
99. Pseudobulbs one-leaved; inflorescences on rudimentary leafless pseudobulbs alternating with the normal ones 100
Pseudobulbs or stems two- or more-leaved 101
100. Column with 2 alae or arms **Chrysoglossum** BL.
Column without appendages **Diglyphosa** BL.
101. Pseudobulbs few-leaved; inflorescence elongate 102
No pseudobulbs; stem usually elongate and more-leaved, rarely short and c. two-leaved; inflorescence short 103
102. Lip faintly 3-lobed; inflorescence nodding at the top.....
Geodorum JACKS.
Lip more or less 3-lobed; inflorescence not nodding.....
Eulophia R. BR.

103. Pollinia without appendages; column foot very short; lip with 2 longitudinal ridges, which are confluent in front ...
Pseuderia SCHLTR.
 Pollinia with stipes and gland; no column foot; lip with 2 longitudinal, free ridges 104
104. Lip not clawed, saecate or spurred at the base **Tropidia** BL.
 Lip spathulate, blade crisp **Corymborchis** THOU.
105. Lip elastically adnate to the column; flowers usually yellow and red; terrestrial **Plocoglottis** BL.
 Lip not adnate to the column; colour of the flowers usually otherwise; usually epiphytes 106
106. Column very short; flowers small ... **Pseudacoridium** AMES
 Column long; flowers usually medium sized or large
Coelogyne LNDL.
107. Sepals united in a ventricose tube; column foot very long, strongly bent, the upper portion free; flowers large
Acanthephippium BL.
 Sepals not forming a ventricose tube 108
108. Lip more or less adnate to the column (the spur leaving out of account) 109
 Lip not adnate to the column 110
109. Column over the whole length adnate to the claw of the lip **Calanthe** R. BR.
 Column adnate to the lip at the base only **Phajus** LOUR.
110. Pseudobulbs one-leaved 111
 Pseudobulbs 2- or more-leaved 112
111. Flowers not resupinate; lip turned upward
Nephelaphyllum BL.
 Lip turned downward **Tainia** BL.
112. Lip with a 2-lobed callus between the lateral lobes; terrestrial **Spathoglottis** BL.
 Lip with longitudinal ridges; epiphytes
Eria LNDL. sect. **Goniorhabdos**
113. Stems with unlimited top growth, often ramified; no rhizome 135
 Stems with limited top growth, the basal portions forming a sympodium (rhizome) covered with scales or sheaths 114
114. Pollinia 4 or 6, on one bifid or on 2 stipites which are each more or less spathulate broadened at the top, inserted at the base of the broadened portion 115

- Pollinia otherwise 116
115. Pollinia 4 **Podochilus** BL.
 Pollinia 6 **Appendicula** BL.
116. Pollinia 2 117
 Pollinia 4 124
 Pollinia 8 127
117. Claw of the lip adnate to the inferior portion of the column
 or to a projecting appendage of it, forming a tubular cavity;
 with pseudobulbs 118
 Lip not adnate to the column in such a way 119
118. Lateral sepals connate; pseudobulbs few-leaved
Acriopsis REINW.
 Lateral sepals free; pseudobulbs one-leaved
Thecostele RCHB. F.
119. Stems more or less climbing, rooting; no rhizome
Dipodium R. BR.
 Stems not climbing and rooting; rhizome present 120
120. Inflorescence very short, dense, sometimes besides terminal
Bromheadia LNDL.
 Inflorescence more or less elongate, loose 121
121. Column with 2 arms; inflorescence very long and loosely
 ramified **Porphyroglottis** RMDL.
 Column without arms; inflorescence simple 122
122. Lip with 3 ridges; pollinia each on a lobe of the short
 stipes **Grammatophyllum** BL.
 Lip with 2 ridges; stipes of the pollinia not lobed 123
123. Lip free from the column; stipes of the pollinia broad
Cymbidium Sw.
 Lip with a very short claw adnate to the column; stipes
 narrow **Cyperorchis** BL.
124. Inflorescences from the pseudobulbs or stems
Dendrobium Sw.
 Inflorescences from the rhizome or at the base of the pseudo-
 bulbs 125
125. Pollinia with caudiculae
Dendrochilum BL. sect. **Eudendrochilum**
 Pollinia without appendages, rarely with a viscous mass. ... 126
126. Pollinia sometimes with a viscous mass (in section **Sestochi-**
los); lip polymorphous **Bulbophyllum** THOU.

- Pollinia without a viscous mass; lip strongly saccate
Pedilochilus SCHLTR.
127. Inflorescence from the base of the pseudobulbs, paniculate
Ridleyella SCHLTR.
 Inflorescence simple 128
128. Concave base of lip separated from the anterior portion by
 transverse thickenings between the lateral lobes
Agrostophyllum BL.
 Lip without transverse thickenings 129
129. Sepals connate in a tube; pseudobulbs depressed globose ...
Porpax LNDL.
 Sepals sometimes connate at the base but not forming a tube;
 pseudobulbs otherwise 130
130. Pollinia on a common, thin stipes 131
 Pollinia not on a common thin stipes 133
131. Floral parts parallel, at least at the base, flowers usually
 hardly opening; lip at the base with a longitudinal thickening,
 with a little, probably nectariferous groove on both sides;
 anther rather long, more or less acuminate ... **Thelasis** BL.
 Floral parts not parallel; lip without a longitudinal thicken-
 ing, but with 2 glands near the base; anther short and
 obtuse 132
132. Stems elongate; leaves laterally compressed; lip not clawed;
 no column foot **Octarrhena** THW.
 Leaves usually not laterally compressed; if so stems very
 short; lip more or less distinctly clawed; column foot present,
 though usually very short **Phreatia** LNDL.
133. Stems elongate; leaves laterally compressed; column recurved,
 ventricose in front, with a cavity; no column foot
Chitonanthera SCHLTR.
 Leaves very rarely laterally compressed; column otherwise;
 column foot present 134
134. Leaves very rarely laterally compressed; pollinia firmly
 attached to the caudicles..... **Eria** LNDL.
 Leaves not laterally compressed; rachis filiform; anther
 2-lobed at the top; pollinia very loosely inserted
Poaephyllum RIDL.
135. Pollinia 8 136
 Pollinia 2 or 4 139

136. Floral parts strongly connivent, only the tips sometimes recurved; anther rather long, acuminate **Thelasis** BL.
Flowers usually well opened, anther short, blunt 137
137. Leaves usually not compressed, but if so stem very short; flowers usually white; lip more or less clawed; column foot present though usually very short **Phreatia** LNDL.
Stems elongate; leaves laterally compressed; lip not clawed; no columnfoot 138
138. Pollinia on a common stipes; column not recurved, not ventricose in front **Octarrhena** THW.
Pollinia not on a common stipes; column recurved, ventricose in front, with a cavity **Chitonanthera** SCHLTR.
139. Leaves with 3 nerves prominent beneath... **Dipodium** R. BR.
Nerves not or only the midrib prominent beneath 140
140. Pollinia 4, nearly equally large, free one from another 141
Pollinia 2, often furrowed or more or less deeply split, or 4 joined in 2 bodies, often unequal 143
141. Leafless; inflorescences more or less elongate, at least the peduncle **Taeniophyllum** BL.
Leafy plants; inflorescences very short 142
142. Leaves laterally compressed; inflorescences 2-flowered; flowers tender, white; lip spurred **Microsaccus** BL.
Leaves thick, often triangular in section, channelled above; inflorescence one- or more-flowered; flower fleshy; lip not spurred **Adenoncos** BL.
143. Sepals and petals more or less connate in a tube which is split up between the lateral sepals; lip spurred; pollinia 2; not rarely leafless **Microtatorchis** SCHLTR.
Sepals and petals free 144
144. Pollinia 4, equal or unequal, united in 2 bodies 145
Pollinia 2, often furrowed or more or less deeply split 164
145. Petals inserted on the column foot; leafless or sometimes with a few small leaves **Chiloschista** LNDL.
Petals not inserted on the column foot or no column foot; leafy plants 146
146. Column foot distinct though sometimes rather short 147
Column foot wanting or obsolete 151
147. Lip not spurred 148
Lip spurred 149

148. Anther at the base with a broad, reverse appendage, which covers the back of the column; pollinia unequal
Calymanthera SCHLTR.
 Anther without appendage; pollinia equal
Cordiglottis J. J. S.
149. Spur thin, not forming a continuation of the narrow column foot; pollinia unequal **Ornithochilus** WALL.
 Spur wide saccate, the back-side forming the continuation of the broad column foot 150
150. Pollinia equal; lip inside without a callus ... **Bogoria** J. J. S.
 Pollinia very unequal, the posterior ones the smallest; lip inside with a callus **Thrixspermum** LOUR.
151. Lip movable or elastically inserted **Arachnis** BL.
 Lip immovable 152
152. Flowers not resupinate, thus lip turned upward, and with the tip of the spur directing upward or towards the top of the inflorescence 153
 Flowers resupinate; lip turned downward 154
153. Lip 3-lobed; lobes small, closing together and with the spur distinctly shoe-shaped; spur with a longitudinal septum ...
Camarotis LNDL.
 Lip not shoe-shaped; spur without a septum but with a transverse scale usually dentate at the apex from the back side **Pomatocalpa** BREDA
154. Rostellum very large, ovate triangular, connected with the column only with the middle of the broad base; spur conic, inside with a transverse wall; flowers very small
Abdominea J. J. S.
 Otherwise 155
155. Lip with appendages near the base of the back-side, that manifestly narrow the entrance of the spur 156
 Lip not with such appendages 157
156. Lip at the base of the back-side with a projecting, horizontal, usually pubescent and more or less linear lamella, usually very complicate in shape and rather a long way adnatē to the column **Trichoglottis** BL.
 Lip at the back-side with a callus variable in shape.....
Sarcanthus LNDL.

157.	Lip with a very wide sac, more or less basin-shaped	
	Gastrochilus D. DON	
	Spur short or long, but not basin-shaped	158
158.	Inflorescence one-flowered; small plant with relatively large flowers	Ceratochilus BL.
	Inflorescence more-flowered	159
159.	Rostellum very long; anther with a long, sharply reflexed beak; small-flowered	Schoenorchis BL.
	Rostellum and anther otherwise	160
160.	Flowers thick, fleshy, usually yellow or yellowish, often dotted red or brown; spur short or hardly saccate	161
	Flowers thin; spur distinct	162
161.	No spur; base of lip concave, rounded behind; in a few species a short spur directed backward	Vandopsis PEITZ.
	Lip at the base very short angular saccate... Acampe LINDL.	
162.	Pollinia very unequal; spur widened at the base; small plants	Saccolabiosis J. J. S.
	Pollinia slightly unequal; spur not widened at the base; large plants	163
163.	Midlobe and sidelobes of the lip nearly on the same level; principal colour of the flowers red, often mottled	
	Renanthera LOUR.	
	Lateral lobes reaching much higher than the midlobe; flowers purple	Ascoglossum SCHLTR.
164.	No distinct spur, but the lip sometimes concave or somewhat saccate at the base	165
	Lip with a distinct spur	172
165.	Column foot distinct	166
	Column foot wanting or very indistinct	170
166.	Lip inserted immovably on the column foot	
	Phalaenopsis BL.	
	Lip inserted movably or elastically	167
167.	Lip strongly bent; leaves compressed laterally or terete ...	
	Cheirorchis CARR	
	Lip not manifestly bent; leaves not laterally compressed or terete	168
168.	Lip with a short, broad, fleshy claw ... Chroniochilus J. J. S.	
	Lip without claw	169
169.	Column long, straight; column foot very short, lip with a	

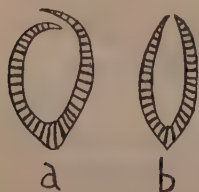
- very small pit at the base **Sarcochilus** R. BR.
 Column short; column foot not very short; lip without a
 cavity at the base **Chamaeanthus** SCHLTR.
170. Flowers very large, flat; habitus of *Vanda* **Euanthe** SCHLTR.
 Flowers small, not flat 171
171. Leaves flat; inflorescences as long as the leaves
Dryadorchis SCHLTR.
 Leaves terete; inflorescences very short, dense, much shorter
 than the leaves **Luisia** GAUD.
172. Lip more or less movable, inserted on the top of the distinct
 column foot 173
 Lip immovable 174
173. Inflorescence viscid; flowers rather fleshy, rather long
 lasting; spur usually conic and incurved, inside with
 appendages **Aerides** LOUR.
 Flowers tender, ephemorous; spur without appendages within
Sarcochilus R. BR.
174. Pollinia much shorter than the stipes 175
 Pollinia not or hardly shorter than the stipes 181
175. Blade of lip large and broad, fleshy, sigmoid or nearly flat,
 entire or shortly 3-lobed at the top; spur pointing backward
 and laterally compressed; leaves usually with longitudinal
 pale stripes **Rhynchostylis** BL.
 Lip 3-lobed; lobes sometimes very small; spur not or dorsally
 compressed; leaves without pale stripes 176
176. Side lobes of lip broad, thin, more or less fimbriate or erose
 at the apex; pollinia on a spatulate stipes
Pennilabium J. J. S.
 Side lobes not thin, not fimbriate or erose 177
177. Column long, arched; lip with 2 calli... **Renantherella** RIDL.
 Column short, straight or recurved 178
178. Stipes of the pollinia broadened towards the base, with a
 large gland; leaf-sheaths warty and ciliate
Hymenorchis SCHLTR.
 Stipes of the pollinia not or broadened upward; leaf-sheaths
 not ciliate 179
179. Inflorescences erect; pedunculus muriculate; rachis thickened
Ascochilopsis CARR
 Inflorescence usually patent or directed downward; peduncle

- not muriculate, glabrous or very rarely pubescent; rachis not thickened 180
180. Spur usually directed backwards or curved, inside at the base without appendages; midlobe thin and narrow (linear) ...
Malleola J. J. S. et SCHLTR.
 Spur usually incurved, the backside with longitudinal ribs or keels within **Robiquetia** GAUD.
181. Inflorescence short, paniculate, wholly red; flowers very small **Porphyrodesme** SCHLTR.
 Inflorescence simple 182
182. Pollinia on a broad stipes 183
 Pollinia on a narrow, linear stipes 184
183. Side lobes of the lip adnate to the column; midlobe acuminate
Pelatantheria RIDL.
 Lip not adnate to the column; midlobe not simply acuminate
Vanda R. BR.
184. Lip at the base adnate to the column; spur bilobed at the top **Omoea** BL.
 Lip not adnate to the column; spur not bilobed 185
185. Midlobe of lip ligulate, sidelobes erect, pressed against the column **Ascocentrum** SCHLTR.
 Midlobe fleshy, callus-shaped; sidelobes not pressed against the column **Saccolabium** BL.

Oakes Ames mentions the genus **Angraecum** BORY for the Philippine Islands. The shape of the column and pollinia are, however, not yet sufficiently known to incorporate it in this key.

A few remarks, which may be of some interest to the users, may find a place here.

It has become obvious to me that the expressions "convolutive" and "duplicative", which refer to the leaf vernation, are yielding difficulties to many persons. Convolutive means that the margins of the young leaf, before it is unfolded, more or less are overlapping one another (a), duplicative that they close together (b). In both cases it may occur that, besides, the leaves are wrinkled. Duplicative, wrinkled leaves have sometimes the appearance of being convolutive (*Microstylis*, *Liparis*).



In the following lists I have enumerated the Orchid genera with convolutive and those with duplicative leaves.

Malayan Orchid genera with convolutive veneration.

(Names in brackets refer to saprophytic plants).

Acanthephippium Bl.	(Gastrodia R. Br.)
Acoridium Nees et Mey.	Geodorum Jack
Anoectochilus Bl.	Goodyera R. Br.
(Aphyllorchis Bl.)	Gynoglottis J. J. S.
Apostasia Bl.	Habenaria Wlld.
Arundina Bl.	Haemaria Lndl.
Basigyne J. J. S.	Herminium L.
Bracisepalum J. J. S.	Herpysma Lndl.
Caladenia R. Br.	Hetaeria Bl.
Calanthe R. Br.	Hylophila Lndl.
Cheirostylis Bl.	Kuhlhasseltia J. J. S.
Chrysoglossum Bl.	(Lecanorchis Bl.)
Claderia Hook. f.	Lepidogyne Bl.
Coelogyne Lndl.	Macodes Lndl.
Corybas Salisb.	Microtis R. Br.
Corymborehis Thou.	Myrmeehis Bl.
Cryptostylis R. Br.	Nabaluia Ames
Cystorehis Bl.	Nephelaphyllum Bl.
Dendrochilum Bl. (excl. sect.	Nervilia Gaud.
Eudendrochilum)	Neuwiedia Bl.
Dicerostylis Bl.	Odontochilus Bl.
(Didymoplexis Griff.)	Orchipedum Breda
Diglyphosa Bl.	(Pachystoma Bl.)
Dilochia Lndl.	Papuaea Schltr.
Disperis Sw.	Peristylus Bl.
Diuris Sw.	Phajus Lour.
Dossinia Morr.	Pholidota Lndl.
(Epipogum Gmel.)	Platanthera L. C. Rich.
Eria Lndl. sect. Goniorhabdos	Platylepis Lndl.
Erythroides Bl.	Plocoglottis Bl.
Eucosia Bl.	Pristiglottis Cretz. et J. J. S.
Eulophia R. Br.	Pseudacoridium Ames
Eurycentrum Schltr.	Pseuderia Schltr.
Galeola Lour.	Pterostylis R. Br.

Sigmatochilus Rolfe
(Silvorchis J. J. S.)
Spathoglottis Bl.
Spiranthes L. C. Rich.
(Stereosandra Bl.)
Tainia Bl.

Thelymitra Forst.
Tropidia Lndl.
Tubilabium J. J. S.
Vanilla Sw.
Vrydagzynea Bl.
Zeuxine Lndl.

Malayan Orchid genera with duplicative veneration.

Abdominea J. J. S.
Acampe Lndl.
Acriopsis Reinw.
Adenoncos Bl.
Aerides Lour.
Aglossorhyncha Schltr.
Agrostophyllum Bl.
Angraecum Bory
Appendicula Bl.
Arachnis Bl.
Ascocentrum Schltr.
Ascochilopsis Carr
Ascoglossum Schltr.
Bogoria J. J. S.
Bromheadia Lndl.
Bulbophyllum Thou.
Calymmanthera Schltr.
Camarotis Lndl.
Ceratochilus Bl.
Ceratostylis Bl.
Chamaecanthus Schltr.
Cheirolechis Carr
Chiloschista Lndl.
Chitonanthera Schltr.
Chroniochilus J. J. S.
Cordiglottis J. J. S.
Cymbidium Sw.
Cyperorchis Bl.
Dendrobium Sw.
Dendrochilum Bl. sect. Eudendro-
chilum

Dipodium R. Br.
Dryadorchis Schltr.
Epiblastus Schltr.
Eria Lndl. (excl. sect. Gonio-
rhabdos)
Euanthe Schltr.
Gastrochilus D. Don
Glomera Bl.
Grammatophyllum Bl.
Hippeophyllum Schltr.
Hymenorchis Schltr.
Ischnocentrum Schltr.
Liparis L. C. Rich.
Luisia Gaud.
Malleola J. J. S. et Schltr.
Medioecalea J. J. S.
Microsaccus Bl.
Microstylis Nutt.
Microtatorechis Schltr.
Oberonia Lndl.
Octarrhena Thw.
Omoea Bl.
Ornithochilus Wall.
Paphiopedilum Pfitz.
Pedilochilus Schltr.
Pelatantheria Ridl.
Pennilabium J. J. S.
Phalaenopsis Bl.
Phreatia Lndl.
Poaeophyllum Ridl.
Podochilus Bl.

Polystachya Lndl.	Saccolabium Bl.
Pomatocalpa Breda	Sarcanthus Lndl.
Porpax Lndl.	Sarcochilus R. Br.
Porphyrodesme Schltr.	Sepalosiphon Schltr.
Porphyroglottis Ridl.	Taeniophyllum Bl.
Renanthera Lour.	Thecostele Rehb. f.
Renantherella Ridl.	Thelasis Bl.
Rhynchostylis Bl.	Thrixspermum Lour.
Ridleyella Schltr.	Trichoglottis Bl.
Robiquetia Gaud.	Vanda R. Br.
Saccolabiopsis J. J. S.	Vandopsis Pfitz.

Herpysma Lndl. This genus was based on a single species from the Himalaya Mountains, *H. longicaulis* Lndl. In 1907 OAKES AMES described a second species, *H. Merrillii* Ames, from the Philippines, but transferred it to *Erythroides* Bl. in 1909 (Orch. III, 79, pl. 54), whereas SCHLECHTER maintained it under *Herpysma*. Shortly C. E. CARR (in Journ. Str. Br. R. As. Soc. XI [1933], 69, pl. 1, fig. B) added a third species to the genus, viz. *H. sumatrana* Carr. However, there is no doubt whatever, that this species is identical with *Erythroides bracteata* Schltr. (*Physurus bracteatus* Bl.), a plant which appears not to be rare in Sumatra. Although the coalescence of the lip with the column is only very slight and not more than in *Erythroides*, I think it advisable to place the species in *Herpysma* for the present. Thus it should bear the name **Herpysma bracteata** J. J. S. n. comb. (*H. sumatrana* Carr, *Physurus bracteatus* Bl., *Erythroides bracteata* Schltr.). It is not impossible that the very blunt anther forms a good generic character, as it is very different from the, so far as I know, always acuminate anther of the species of *Erythroides*.

Orchipedum Breda. This genus was first described and figured by BREDA in 1827 (Gen. et sp. Orch., fasc. II, t. 5). In 1858 BLUME (Fl. Jav. n. ser. I, 99, t. 27, fig. 1) changed the name in *Queteletia* Bl., on account of the older name *Orchipeda* Bl. (*Apocynaceae*); he re-described the only species under the name *Q. plantaginifolia* Bl. and copied BREDA's plate. According to Dr J. TH. HENRARD, our Dutch expert for nomenclatural affairs, there is no reason why *Orchipedum* Breda should not stand.

After KÜHL and VAN HASSELT the plant was not collected again and remained somewhat doubtful, until in 1929 it was redetected in Java

by Dr C. G. G. J. VAN STEENIS and Mr. R. C. BAKHUIZEN VAN DEN BRINK. Dried material and a photograph enabled me to state that the published figure and description are in general very good but that they are incorrect in a few details. In the first place the base of the lip is distinctly adnate to the column, and secondly the calli in the spur are no real calli but tufts of weak processes not unlike those which are found in the base of the lip of *Platylepis* Bl. and also which cover the inner surface of the ventricose part of the lip of *Goodyera* R. Br.

It became also clear that *Orchipedum* Breda covers entirely the genus *Philippinaea* Ames et Schltr. (in AMES Orch. VI, 1920, 278, pl. 100) from the Philippines, and that the only species should bear the name **Orchipedum Wenzelii** J. J. S. n. comb. (*Philippinaea Wenzelii* Ames et Schltr., *Adenostylis Wenzelii* Ames). According to the description and plate this species differs from the Javanese one in the much narrower leaves, the narrower anterior lobe of the lip and the appendages in the base of the lip being clavate.

The geographical distribution of the genus, at least so far as we know as yet, viz. one species in Java and one in the Philippines, is certainly remarkable.

Thelasis Bl. R. SCHLECHTER has (in Laut. Beitr. zur Fl. von Papuasien IX [1923], 148) based on his sections *Diplostypus* and *Rhynchophreatia* of *Phreatia*, which agree with my section *Hemithelasis* of *Thelasis*, his genus *Rhynchophreatia*. When proposing the section *Hemithelasis* I have expressed the opinion that this section in future perhaps should be raised to specific rank. In this way SCHLECHTER was thus with me.

Provisionally I think it correct to maintain the section under *Thelasis*, the floral structure not showing any difference with this genus, just as I have pointed out formerly. The divergence is to be found in the vegetative parts, in which the section is similar to my section *Rhizophyllum* or SCHLECHTER's *Eu-Phreatia* of *Phreatia*.

SCHLECHTER's description of the thickening of the lip is not wholly accurate. It is not 'ein deutlicher, dicker, nach hinten gerichteter Kallus am Grunde des Labellums', but a thick longitudinal ridge, which is not free at the back end, but adnate to the base of the column and with a nectary on both sides, just like in other species of *Thelasis*.

Chiloschista Lindl. R. MANSFELD has (in Notizbl. Berlin XI, nr. 106 (1932), 491), chiefly following SCHLECHTER, united a few species of the

genus *Sarcochilus* R. Br., on which I based my section *Perspicilla*, with *Chiloschista* Lindl. I cannot follow him in this matter, as the principal differentiating character, the curious appendages of the anther, seems to me only of secondary value, which opinion is supported by the fact, that in one of the species these appendages are wholly lacking. In excluding the species which SCHLECHTER and MANSFELD added to it, *Chiloschista* is a sharply limited genus, whereas the limits grow unstable in adding to it a few species with a quite other flower-structure.

Rhynchostylis Bl. SCHLECHTER has (Orch. 1915, 587) founded his genus *Anota* on a few species which had been placed variously in *Saccolabium*, *Vanda* and *Rhynchostylis*. I have always had the idea that there was something unnatural in admitting a genus *Anota* next to *Rhynchostylis*, but for want of good material I could not judge of it definitely. Now I am much obliged to Mr. ED. QUISUMBING, Manila, for kindly forwarding to me flowers in formaline of *Rhynchostylis retusa* Bl. and *Anota violacea* Schltr. I have failed to find any differences of generic value which would justify the maintenance of a genus *Anota*. In *Rhynchostylis retusa* Bl. there is a rather distinct but short column-foot on which the lateral sepals are decurring, but in *Anota violacea* Schltr. it is not wanting, though shorter, as is clearly shown in the magnificent and accurate plate published recently by ED. QUISUMBING (in Phil. Journ. Sc., vol. 52 (1933), 271, pl. 1—3). The insertion of the lip, the column and pollinia do not show any essential characters, so that the Philippine species should bear the name ***Rhynchostylis violacea*** Rehb. f.

There appear to exist some differences between the specimens of *Rhynchostylis retusa* in Java and in the Philippines. QUISUMBING describes the flowers as odourless, whereas in Java they are strongly fragrant, and he describes the petals as oblong-ovate and rounded, whereas they show in the Java specimens exactly the same form as in QUISUMBING's figure of *Anota violacea*.

**REVISION DER VON OZEANIEN, AUSTRALIEN UND
NEUSEELAND ANGEFÜHRTEN LEJEUNEACEAE HOLOSTIPAE**
(de Frullaniaceis XIV)

von

FR. VERDOORN

(Leiden)

In dieser Arbeit habe ich versucht, eine möglichst vollständige Revision aller von Ozeanien, Australien und Neuseeland angeführten Holostipae zu geben. Mit nur sehr wenigen Ausnahmen konnte ich fast alle Originale untersuchen. Ich habe auch den grössten Teil der Belege für die anderen Literaturangaben rediviert. Im folgenden werden nur Fundorte genannt, von denen ich Material untersuchen konnte.

Die vorliegende Arbeit schliesst sich eng an meine Bearbeitung der Holostipae in „Nova Guinea“ XVIII:1—8 (1934) an. Früher, 1930, de Frullan. VIII (Nederl. Kruidk. Arch. 1930, p. 155—175), habe ich eine Revision der ozeanischen Frullanien gegeben. Damals wies ich schon auf die relativ kleine Anzahl der endemischen Arten Ozeaniens hin. Für die Holostipae kann man dasselbe feststellen. Die meisten ozeanischen Frullanien und Lejeuneen sind mit indomalayischen oder pantropischen Arten identisch oder nahe verwandt. Mehrere der in Ozeanien verbreiteten Jubuleen erreichen wohl die Marianen, Samoa, Tahiti, etc., fehlen aber auf Hawaii. Die meisten Inselgruppen besitzen einige endemische Arten, welche meistens deutliche Beziehungen zu indomalayischen Arten zeigen. Die auffallendsten und isoliertesten Endeme finden wir auf Neu-Kaledonien. Deutliche Beziehungen zwischen den Jubuleen von Australien und Neu-Kaledonien sind nicht festzustellen. Ausser typisch indomalayischen Sippen begegnen wir in Ozeanien einigen, wenn auch nicht vielen, rein neotropischen Gattungen, welche teilweise nur bis Hawaii, teilweise aber bis Australien, Neu-Seeland und bis Neu-Guinea vordringen.

Die Frullaniaceenflora von Australien und Neu-Seeland ist durch eine sehr grosse Anzahl endemischer Arten charakterisiert. Diese weisen zum grössten Teil weder Beziehungen zu den indomalayischen (und

ozeanischen), noch zu den neotropischen (wohl aber zu antarktischen) Arten auf. Die Holostipae von Australien und Neu-Seeland zeigen auch, wenn man nicht nur von Funden in Queensland ausgeht, etwas mehr Verwandtschaft zu indomalayischen (und ozeanischen) Arten als die Frullanien. Doch stehen auch hier die meisten ziemlich isoliert. Nach der Untersuchung der Frullanien und Holostipae von Neu-Guinea lässt sich Folgendes sagen. Auf Neu-Guinea finden wir hauptsächlich indomalayische Jubuleen; dabei entstanden nur selten endemische Kleinarten. Dann kommen merkwürdige endemische Sippen (keine endemische Gattungen, sondern verwandtschaftlich völlig isolierte polymorphe Sektionen) vor. Schliesslich finden wir einige wenige neotropische Elemente (die sich alle auch in Ozeanien oder Australien finden) und ganz wenige, sonst auf Australien (oder Australien und das südl. extratrop. Amerika) beschränkte Elemente.

Für die Ueberlassung von grösseren rezenten Kollektionen schulde ich den Herren Prof. Dr W. A. SETCHELL in Berkeley, Cal. (Reise mit PARKS nach Tahiti, im J. 1922), dem Bernice P. Bishop Museum in Honolulu (verschiedene Hawaii-Kollektionen), Mr. K. W. ALLISON in Rotorua (Neu-Seeland Kollektionen) und Mrs. E. A. HODGSON in Turiroa (idem) herzlichen Dank.

Weiter bin ich den Herbarien und Museen in Berlin (Dr H. REIMERS); Genf, Herb. Boissier (Prof. R. CHODAT und Dr G. BEAUVERD); Kew; Leiden; Paris (Dr P. ALLORGE); New York (Dr M. A. HOWE); Strassbourg; Wien, Naturhist. Museum (Dr K. KESSLER), sowie den Herren Prof. Dr AL. W. EVANS (New Haven, Conn.), Prof. Dr TH. HERZOG (Jena), Mr. W. E. NICHOLSON (Lewes) und Prof. Dr V. SCHIFFNER (Wien) für die Hilfe beim Aufsuchen vieler Originale zu grossem Dank verpflichtet.

Acrolejeunea cucullata Steph. 1890 nom. nud., Hedwigia 29:10; 1907, Denkschr. Ak. Wiss. Wien 81:295 = *Ptychocoleus pycnocladus* (Tayl.) Steph.

Acrolejeunea fertilis (Rw. Bl. N.) Spr. 1884, Hep. Am. et And. p. 116; Steph. 1907, Denkschr. Ak. Wiss. Wien 81:295 = *Ptychocoleus fertilis* (Rw. Bl. N.) Trev.

Acrolejeunea marquesana Steph. 1905, Hedwigia 34:58 = *Ptychocoleus Cumingianus* (Mt.) Trev.

Acrolejeunea Novae Guineae Steph. 1889, Hedwigia 28:165, 1907. Denkschr. Ak. Wiss. Wien 81:295 = *Ptychocoleus Novae Guineae* (Steph.) Steph.

Acrolejeunea Rechingeri Steph. 1910, Denkschr. Ak. Wiss. Wien 85:195 = *Ptychocoleus Rechingeri* (Steph.) Steph. = *Ptychocoleus Hasskarlianus* (Gottsche) Steph.

Acrolejeunea securifolia Steph. 1890, Hedwigia 29:133 = *Ptychocoleus securifolius* (Endl.) Steph.

Acrolejeunea subinnovans Steph. 1895, Hedwigia 34:59 = *Ptychocoleus pycnocladus* (Tayl.) Steph.

Acrolejeunea Wildii Steph. 1889, Hedwigia 28:165 = *Ptychocoleus Wildii* Steph.

1. **Archilejeunea australis** St. 1911, Sp. Hepat. IV:734. Unterscheidet sich von der verwandten *A. caramuensis* durch flächere Blätter (besonders der antikale Lobusrand ist weniger eingerollt) und vor allem durch die um 20 % kleineren, regelmässig verdickten Zellen, welche auch in der Lobusmitte mehr isodiametrisch sind, als dies bei *A. samoana* der Fall ist. Amphigastrien gross, rund, an der Insertion etwas breiter als bei *A. caramuensis*. Weiter hat *A. samoana* einen autözischen Blütenstand, während *A. australis* anscheinend monoözisch ist; ich konnte kein einziges Andrözium zwischen den zahlreichen weiblichen Pflanzen auffinden. Nach dem heutigen Stande unseres Wissens kommt *A. samoana* in Australien nicht vor. Australien (New S. Wales).

Archilejeunea bilabiata (Mitt.) Steph. 1911, Spec. Hepat. IV:723 cf. sub *Phragmicoma*.

2. **Archilejeunea brachyantha** Jack et Steph. 1894, Bot. Centralbl. 60:105; Steph. 1911, Spec. Hep. IV:723, Verd. 1933, de Frull. XII:81. Von *A. caramuensis* leicht zu unterscheiden durch den stark eingebogenen (nicht eingerollten) antikalen Lobusrand, durch viel grössere flache Lobuli und kleinere Amphigastrien. Der Lobulus ist zwar nach demselben Prinzip aufgebaut wie der Lobulus von *A. caramuensis* (2 laterad gerichtete Zähne etc.), aber immer (an allen Pflanzen und an allen Blättern) gut entwickelt und im Verhältnis zu den Lobuli, doppelt so gross wie bei *A. caramuensis*. STEPHANI nennt in seinen Spec. Hep. l.c. die Art für Malacca, sie wurde dort jedoch niemals gefunden. Es handelt sich um eine Verwechslung mit *P. pycnocladus*. Fidschi Inseln.

Archilejeunea Brotheri Steph. 1911, Spec. Hepat. IV:723 = *Ptychocoleus pycnocladus* (Tayl.) Steph.

Archilejeunea calcarata (Mitt.) Steph. 1911, Spec. Hepat. IV:724 = *Mastigolejeunea calcarata* (Mitt.) Verd.

Archilejeunea caledonica Steph. 1911, Spec. Hepat. IV : 724 = *Thysananthus polymorphus* Sde Lac.

Archilejeunea caramuensis Steph. 1895, Hedwigia 34:59; 1911 Spec. Hepat. IV : 725 = *Archilej. samoana* Steph.

3. **Archilejeunea Etesseana** (Steph.) comb. nov. Steht *A. olivacea* ziemlich nahe, ist aber doppelt bis dreimal so gross, weiterhin sind die Amphigastrien viel breiter und die grossen Lobuli laufen in zwei grosse ziemlich breite Spitzen aus. Die ♀ Infl. habe ich nicht gesehen, nach der Zeichnung *Stephani's* dürften die breiten Lobuli des Inv. charakteristisch sein. Neu-Kaledonien.

Archilejeunea falcata Steph. 1895, Hedwigia 34:60; 1911, Spec. Hepat. IV : 60 = *Archilejeunea mariana* (Gottsche) Steph.

4. **Archilejeunea falcifolia** St. 1910, Denkschr. Ak. Wiss. Wien 85:196; 1911, Spec. Hepat. IV : 726. Vielleicht durch die grob und weit gezähnten Involucralblätter von *A. mariana* zu trennen. Andere Unterscheidungsmerkmale sind nicht anzugeben. Beide Arten sind monoezisch und stimmen in der Gestalt und besonders auch in der charakteristischen Faltung der Blätter und Amphigastrien völlig überein. Bei *A. mariana* beobachtet man manchmal gezähnte Amphigastrien, aber deutlich gezähnte Involucralblätter sah ich nie. Bougainville.

Archilejeunea Graeffei J. et St. 1894, Botan. Zentralbl. 60, 4; Steph. 1911, Spec. Hepat. IV : 727 = *Pycnolejeunea* sp. Hierher gehört auch *A. Michlitzii* St.

5. **Archilejeunea incrassata** Steph. 1908, Rev. Bryol. 35:30; 1911, Spec. Hepat. IV : 728. Durch ihre geringe Grösse, Zellnetz etc. vorzüglich unterschiedene Art, autözisch. Neu-Kaledonien.

Archilejeunea Kaernbachii Steph. 1910, Denkschr. Ak. Wiss. Wien 85:195 gehört zu den Schizostipae. Cf. de Frullan. XV.

6. **Archilejeunea mariana** (Gottsche) Steph. 1911, Spec. Hepat. IV : 729. Cf. de Frull. XV. Formosa, Vorderindien, Siam, Annam, P. Penang, Sumatra, Java, Borneo, Philippinen, Celebes, Neu Guinea, Mioko, Marianen, Yap, Neu Kaledonien, Salomon Inseln, Samoa, Cook Inseln, Tahiti, Hawaii.

Archilejeunea Michlitzii Steph. 1911, Spec. Hepat. IV : 729 = *Archilejeunea Graeffei* Jack et Steph. = *Pycnolejeunea* spec.

Archilejeunea Novae Caledoniae Steph. 1911, Spec. Hepat. IV : 729 = *Pycnolejeunea* spec. In den Icones Ined. sind die Amphig. als „holostipa“ abgebildet, sie sind aber deutlich „schizostipa“. Eine Verwech-

lung ist ausgeschlossen, da alle andere Angaben in den Spec. Hepatic. und die weiteren Abb. völlig mit dem Originalmaterial übereinstimmen. Ob es sich um eine schon beschriebene oder neue *Pycnolejeunea* handelt, kann ich nicht beurteilen.

7. ***Archilejeunea olivacea*** (Hook. f. et Tayl.) Steph. 1911, Spec. Hepat. IV:734. Leicht von *A. caramucensis* und Verwandten zu unterscheiden. *A. brachyantha* von den Fidjisch-Inseln steht näher, ist aber in allen Dimensionen viel kleiner, hat fast runde schmalere Amphigastrien und viel kleinere Zähne an den Lobuli. Die ♀ Involucra der beiden Arten dürften sich auch nicht völlig gleichen, ich kann das aber an dem spärlichen Material nicht mit Sicherheit feststellen. Belege für MITTEN'S Angabe: Samoa und Raiatea sah ich nicht. Wahrscheinlich sind sie, besonders die erste, unrichtig. Neu-Seeland, Chatham Inseln.

Archilejeunea owahuensis (Gottsche ms.) Steph. 1911, Spec. Hepat. IV:730 = *Archilejeunea mariana*. Wie ich in de Frull. XII:81 schon mitteilte, hat STEPHANI auch manchmal *Brachiolejeunea sandwicensis* mit dem Namen *A. owahuensis* belegt. In den Kollektionen von FAURIE ist *Thysananthus polymorphus* als *A. owahuensis* det. STEPHANI herausgegeben.

8. ***Archilejeunea robusta*** (Steph.) Verd. comb. nov. Verwandt mit *A. olivacea* und *A. scutellata*, aber sehr viel grösser. Lobuli meistens mit zwei Spitzen, Lobi zugespitzt, ♀ Involucralbl. ganzrandig. Perianthium mit 2 deutlichen ventralen Falten. Australien (N. S. Wales).

Archilejeunea samoana (Mitt.) Steph. 1911, Spec. Hepat. IV:731. Diese Pflanze ist mit der verbreiteten *A. Mariana* (= *A. caramucensis*) völlig identisch. In den Ic. Ined. ist auch noch eine „*Archilejeunea samoana* St. n. sp.“ abgebildet (ausser MITTEN'S Original, von dem ebenfalls eine Zeichnung vorliegt), diese Pflanze gehört aber zu *Ptychocoleus* (Samoa, leg. Schauinsland, herb. Brotherus).

9. ***Archilejeunea scutellata*** (Hook. f. et Tayl.) Steph. 1911, Spec. Hepat. IV:735. Einer robusten *A. mariana* nicht unähnlich, aber durch grössere zugespitzte, distad gerichtete Lobi, kleinere eingerollte Lobuli, grosse längliche Perianthien, etc. deutlich zu unterscheiden. Neu-Seeland, Ost-Australien.

Archilejeunea tahitensis Steph. 1911, Spec. Hepat. IV:732 = *Mastigolejeunea humilis* (Gottsche) Spr.

Archilejeunea vanicorensis Steph. 1911, Spec. Hepat. IV:733 = *Mastigolejeunea vanicorensis* (Steph.) Verd. comb. nov.

10. ***Archilejeunea Wattsiana*** (Steph. 1924 Spec. Hepat. VI:559.

Steht *A. olivacea* sehr nahe, hat aber ein gezähntes ♀ Involuerum; manchmal sind auch die f. subinv. gezähnt. Die Zähne der Lobuli sind anders gestaltet als bei *A. olivacea*. Ob alle diese Merkmale zu einer spezifischen Trennung berechtigen, ist mit Sicherheit erst nach dem Studium eines grösseren Materials zu entscheiden. Australien (Lord Howe Island).

Brachiolejeunea aliena Steph. 1897, Bull. Herb. Boiss. V : 842 = *Thysananthus polymorphus* Sde Lac.

Brachiolejeunea apiculata Steph. 1897, Bull. Herb. Boiss. V : 846 = *Thysananthus polymorphus* Sde Lac.

Brachiolejeunea Eavesiana (Gottsche) Steph. 1912, Spec. Hepat. V : 140 = *Archilejeunea scutellata* (Hk. f. et Tayl.) Steph.

Brachiolejeunea erectiloba Steph. 1912, Spec. Hepat. V : 138 ist entweder eine robuste Form von *Ptychocolus pycnocladus* oder eine nahe verwandte endemische Art. Ohne reichlichere Aufsammlungen kann ich darüber nicht entscheiden.

Brachiolejeunea Etesseana Steph. 1912, Spec. Hepat. V : 133 = *Archilejeunea Etesseana* (Steph.) Verd. comb. nov.

Brachiolejeunea flavovirens Steph. 1910, Denkschr. Ak. Wiss. Wien 85:200, 1912 Spec. Hepat. V : 131 = *Thysananthus planus* Sde Lac.

Brachiolejeunea Frauenfeldii (Reich.) Steph. 1912, Spec. Hepat. V : 131 = *Mastigolejeunea Frauenfeldii* (Reich.) Steph.

Brachiolejeunea gibbosa (Aongstr.) Steph. 1912, Spec. Hepat. V : 132 = *Mastigolejeunea Frauenfeldii* (Reich.) Steph.

Brachiolejeunea Heussleri Steph. 1912 Spec. Hepat. V : 140 = *Archilejeunea olivacea* (Hk. f. et Tayl.) Steph. Leider konnte ich nur steriles Material untersuchen, dies ist üppig entwickelt, stammt wahrscheinlich von einem feuchten Standort, infolgedessen sind die Lobuli an ihren Rändern nur wenig differenziert. Man findet meistens 1 oder 2 nur ganz kleine Spitzchen, hier und da sind sie aber grösser und stimmen dann, wie übrigens alle anderen Teile der Pflanze, mit *A. olivacea* völlig überein.

Brachiolejeunea japonica Steph. 1897, Bull. Herb. Boissier V : 842 = *Brachiolejeunea sandvicensis* (Gottsche) Evs. In FAURIE's Kollektionen sind Hawaii-Pfl. unter dem obenstehenden Namen herausgegeben.

Brachiolejeunea Kirkii Steph. 1912, Spec. Hepat. V : 141 = *Archilejeunea scutellata* (Hk. f. et Tayl.) St.

Brachiolejeunea miokensis Steph. 1912, Spec. Hepat. V : 132 = *Mastigolejeunea humilis* (Gottsche) Spr.

Brachiolejeunea plagiochiloides Steph. 1889, Hedwigia 28 : 167; 1912, Spec. Hepat. V : 141. Das Original stammt vom „Schoolhaven“ und wurde dort von BAEUERLEN gesammelt, leider konnte ich es nicht untersuchen. Material von W. W. WATT, das STEPHANI als *B. plagiochiloides* bestimmte, gehört teilweise zu *Archilej scutellata*, teilweise zu *Mastigolejeunea*. Der Zeichnung nach ist das Originalmaterial wahrscheinlich auch zu *A. scutellata* zu stellen. Um eine echte *Brachiolejeunea* handelt es sich jedenfalls nicht.

Brachiolejeunea robusta Steph. 1912, Spec. Hepat. V : 141 = *Archilejeunea robusta* (Steph.) Verd. comb. nov.

11. **Brachiolejeunea sandvicensis** (Gottsche) Evs. 1900, Transact. Conn. Acad. X : 419. Japan, Formosa, China, Tonkin, Annam, Vorderindien, Tahiti, Hawaii.

Brachiolejeunea sexplicata Steph. 1912, Spec. Hepat. V : 136 = *Brachiolejeunea sandvicensis* (Gottsche) Evs.

Brachiolejeunea Thozetiana (Gottsche et Müll.) Steph. 1912, Spec. Hepat. V : 142. Das Originalmaterial war nicht aufzufinden.

Brachiolejeunea Wattsiana Steph. in sched. = *Mastigolejeunea phaea* (Gottsche msc.) Steph.

Bryopteris filicina Nees. REICHARDT 1870, Reise der Novara p. 156 gibt diese Art an für Tahiti und bemerkt dazu: „diese Art ist somit auch auf den Inseln des stillen Ozeans verbreitet“. Die betreffende Angabe bezieht sich aber auf *Thysananthus fruticosus*.

Bryopteris striata (Lehm. et Lindenb.) Mitt. 1871, Fl. vit. p. 411 = *Ptychanthus striatus* (L. et L.) Nees.

Bryopteris Sinclairii Mitt. 1862, Bonplandia 10 : 19; 1871, Fl. vitiensis p. 411 = *Thysananthus fruticosus*. (Lindenb. et G.) Schiffn.

12. **Caudalejeunea circinata** Steph. 1912, Spec. Hepat. V : 13. Cf. de Frull. XV. Java, Borneo, Ceram, Neu-Kaledonien.

Caudalejeunea longistipula Steph. 1912, Spec. Hepat. V : 14 = *Thysananthus fruticosus* (Lindenb. et G.) Schiffn.

Caudalejeunea miokensis Steph. 1912, Spec. Hepat. V : 15 = *Caudalejeunea reniloba* (Gottsche) Steph.

Caudalejeunea recurvistipula (Gottsche) Steph. = *Caudalej. reniloba* (Gottsche) Steph.

13. **Caudalejeunea reniloba** (Gottsche) Steph. 1912, Spec. Hepat. V : 16. Cf. de Frull. XV. Siam, Andamanen, Java, Sumatra, Malayischer Halbinsel, Philippinen, Borneo, Celebes, Ceram, Neu-Guinea, Mioko, Marianen,

Queensland, Neu-Kaledonien, Ferguson Inseln, Admiralty Inseln, Samoa, Tahiti.

14. **Caudalejeunea samoana** Steph. 1907, Denkschr. Ak. Wiss. Wien 81:296; 1912, Spec. Hepat. V:16. Erinert einigermassen an *C. Stephanii* Spr., ist aber durch Grösse und die eigentümlichen fransig gezähnten Lobuli und Involucralblätter sofort zu erkennen. Samoa.

Caudalejeunea Stephanii (Spr. msc.) Steph. 1912, Spec. Hepat. V:17. Die Angabe von STEPHANI 1907 (Denkschr. Ak. Wiss. Wien 81:296) kann kaum richtig sein, da *C. Stephanii* auf die Indomalaya beschränkt ist. Cf. auch sub *Thysan. planus* Sde Lac.

Dicranolejeunea Didericiana Steph. 1896, Hedwigia 35:77 = *Thysananthus polymorphus* Sde Lac.

Dendrolejeunea vittata (Mitt.) Steph. 1885, Hedwigia 24:90 = *Thysananthus fruticosus* (Lindenb. et G.) Schffn.

Harpalejeunea ? cuneistipula Steph. 1913, Spec. Hepat. V:267. Cf. sub *Phragmicoma cuneistipula* Mitt.

Jungermania olivacea Hook. f. et Tayl. 1844, Lond. Journ. Bot. III:568 = *Archilejeunea olivacea* (Hk. f. et Tayl.) Steph.

Jungermania securifolia Endl. 1833, Prodr. Fl. Norf. p. 5 = *Ptychocoleus securifolius* (Endl.) Steph.

Lejeunea aliena (nec *alcina*; sphalm!) Aongstr. 1872, Oefv. Kgl. Vet. Akad. Förh. 1872, 4, pag. 23 = *Thysananthus polymorphus* Sde Lac.

Lejeunea anguiformis (Hk. f. et Tayl.) Mitt. 1855, Fl. Nov. Zel. p. 157 = *Thysananthus anguiformis* (Hk. f. et Tayl.).

Lejeunea apiculata Steph. 1898, in Besch. J. de Bot. XII, Sep. p. 6 = *Brachiolejeunea apiculata* Steph. = *Thysan. polymorphus* Sde Lac.

Lejeunea auriculata (Wils. et Hook.) Sull. 1856, Gray, Manual, Ed. II, p. 699; Steph. 1898, in Besch., J. de Bot. XII, Sep. p. 6. Cf. sub *Mastigolejeunea*.

Lejeunea cryptocarpa Mitt. 1871, Fl. vitiensis p. 413 = *Symbyezidium cryptocarpum* (Mitt.) Steph.

Lejeunea Cumingiana (Mont.) Mitt. 1861, Hep. Ind. Orient. p. 110; Steph. 1898, in Bescherelle, J. de Bot., Sep. p. 4 = *Ptychocoleus Cumingianus* (Mt.) Trev.

Lejeunea elongata Aust. 1874, Bull. Torrey Bot. Cl. V:17 = *Thysananthus polymorphus* Sde Lac.

Lejeunea eulopha Tayl. 1846, L. Journ. Bot. V:391; Steph. 1898 in Besch. Journ. de Bot. XII, Sep. p. 6 = *Lopholejeunea eulopha* (Tayl.) Spr.

Lejeunea filicina (Sw.) Steph. 1898, in Besch. J. de Bot. XII, Sep. p. 4. Cf. sub *Bryopteris*.

Lejeunea fimbriata (Gottsche 1880, in Müll., Phragm. Phytog. Austr. XI: 64 = *Lopholej. eulopha* (Tayl.) Spr.

Lejeunea Frauenfeldii (Reich.) Steph. 1898, in Besch. J. de Bot. XII, Sep. p. 4 und p. 7. (sic!) = *Mastigolejeunea Frauenfeldii* (Reich.) Steph.

Lejeunea gibbosa Aongstr. 1872, Oefv. Kgl. Vet. Ak. Förrh. 1872, 4, pag. 23 (nec 1873, pag. 133) = *Lopholejeunea subnuda* (Mitt.) Steph.

Lejeunea guahamensis Lindenb. 1845, Syn. Hepat., p. 333 = *Mastigolejeunea humilis* (Gottsche) Spr.

Lejeunea Hasskariiana (Gottsche) Steph. 1898, in Besch., J. de Botan. XII, Sep. p. 4 = *Ptychocoleus Hasskarlianus* (Gottsche) Steph.

Lejeunea ligulata (Lehm. und Lindenb.) Mitt. 1861 Hep. Ind. Or. p. 110; Steph. 1898, in Besch. J. de Bot. XII, Sep. p. 6. Cf. sub *Mastigolejeunea*.

Lejeunea mariana Gottsche 1845, Syn. Hepat., p. 337 = *Archilejeunea mariana* (Gottsche) Steph.

Lejeunea marquesiana Steph. 1998 nom. nud., in Besch., J. de Bot. XII, Sep. p. 4 = Cf. sub. *Ptychocoleus marquesianus* (Steph.) Steph.

Lejeunea mollis (Hook. f. et Tayl.) Mitt. 1855, Fl. Nov. Zel. II : 156 = *Ptychocoleus mollis* (Hk. f. et Tayl.) Steph.

Lejeunea olivacea (Hk. f. et Tayl.) Syn. Hepat. 1845, p. 334 = *Archilejeunea olivacea* (Hk. f. et Tayl.) Steph.

Lejeunea ophiocephala Mitt. 1855, Fl. of New Zealand II : 156; Hook. f. 1864—67 Handb. Ned Zealand Fl. p. 532 = *Thysananthus ophiocephalus* Tayl., welche zu *Thys. anguiformis* Hook et Tayl. gehört.

Lejeunea pallida (Aongstr.) Steph. 1898, in Besch., J. de Bot. XII, Sep. p. 4 = *Ptychocoleus pallidus* (Aongstr.) Steph.

Lejeunea plicatiscypha Syn. Hepat. 1847 pag. 7+8 = *Lopholejeunea plicatiscypha* (Hook. f. et Tayl.) Steph.

Lejeunea procumbens Mitt. 1871, Flora vitiensis p. 413. STEPHANI stellt die Pflanze zu *Hygrolejeunea*. Da er aber nur die kurze Diagnose MITTEN's wiederholt, hat er wahrscheinlich kein Material gesehen. Es konnte sich auch um irgend eine Art der Holostipae handeln.

Lejeunea renistipula Gottsche in sched. = *Lopholejeunea Vescoana* Steph. = *Lopholejeunea eulopha* (Tayl.) Spr. Cf. besonders Steph. 1898 in Besch., J. de Botan. XII, Sep. p. 5 (no. 22).

Lejeunea samoana Mitt. 1871, Fl. vitiensis p. 415 = *Archilej. samoana* Steph. = *Archilejeunea mariana* (Gottsche) Steph.

Lejeunea sandvicensis Evs. 1892 Transact. Conn. Ac. VIII:253, Steph. 1898, in Besch. J. de Bot. XII, Sep. p. 4 = *Brachiolejeunea sandvicensis* (Gottsche) Evs.

Lejeunea scutellata (Hk. f. et Tayl.) Mitt. 1855, Fl. Nov. Zel. II:155 = *Archilejeunea scutellata* (Hk. f. et Tayl.) Steph.

Lejeunea squamata (Willd.) Nees 1845, Syn. Hepat. 322, Cf. sub *Stictolejeunea squamata*.

Lejeunea Stephensoniana Mitt. 1855, Fl. Nov. Zel. II:155, Cf. sub *Ptychanthus*.

Lejeunea subfusca (Nees) Syn. Hepat. 1845, p. 315; Steph. 1897, in Besch., J. de Bot. XII, Sep. p. 6 = *Lopholejeunea subfusca* (Nees) Steph.

Lejeunea subsquarrosa Aust. 1874, Bull. Torrey Bot. Club V:15 = *Brachiolej. sandvicensis* (Gottsche) Evs.

Lejeunea taitica (nec *tahitica*) (Gottsche in sched. et in ic.) Steph. nom. nud. 1898, J. de Bot. XII, Sep. p. 6 = *Mastigolej. humilis* (Gottsche) Spr.

Lejeunea transversalis Hookeriana Syn. Hepat. 1845, p. 311 = *Symbyezidium bacciferum* (Tayl.) Steph.

Lejeunea Vieillardii Gottsche in sched. = *Lopholejeunea eulopha* (Tayl.) Spr.

Lejeunea virens (Aongstr.) Steph. 1898, J. de Bot. XII, Sep. p. 7 = *Mastigolejeunea humilis* (Gottsche) Spr.

15. *Lopholejeunea australis* Steph. 1912, Spec. Hepat. V:96 ist nahe verwandt mit *L. subfusca*, lässt sich aber wohl spezifisch trennen durch die etwas anders gebildeten Lobuli, durch die ganzrandigen laterad gerichteten Lobi inv. ♀, und durch das freie, nur mit einigen kleinen Stacheln versehene Perianth. *L. australis* zeigt hier und da zugespitzte Lobi, ohne jedoch mit *L. nigricans* etc. verwandt zu sein. *L. subfusca* ist mir aus Australien unbekannt. — Australien (N. S. Wales).

Lopholejeunea caledonica St. in sched. = *Archilejeunea incrassata* Steph.

16. *Lopholejeunea Colensoi* Steph. 1892, J. Linn. Soc. Bot. 29:268; 1912, Spec. Hepat. V:97. Durch sehr breite Lobuli, einen eigentümlichen eingebogenen postikalen Lobusrand und die zahlreichen, länglichen, ganzrandigen Auswüchse, welche das Perianth völlig bedecken, gut charakterisiert. *L. latilobula* Verd. aus Neu-Guinea hat ähnliche Lobuli. Der

Lobusrand verläuft jedoch anders, die ♀ Involucralblätter sind im Gegensatz zu denen von *L. Colensoi* deutlich gezähnt, während die Kiele des Perianths, obwohl ziemlich gross und fransig gezähnt, gar nicht mit denen der *L. Colensoi* übereinstimmen. Neu-Seeland.

17. **Lopholejeunea eulopha** (Tayl.) Spr. 1884, Hepat. Amaz. et Andin. pag. 120. Die Gestalt der Lobuli, sowohl an den gewöhnlichen Blättern, wie auch im ♀ Involucrum, ist sehr variabel und kann sogar an derselben Pflanze stark wechseln (Spitze!) Die Lobi sind an fertilen Aesten bisweilen deutlich zugespitzt. Cf. de Frull. XV. Nikobaren, Sumatra, Malayische Halbinsel, Java, Borneo, Philippinen, Halmahera, Ambon, Neu-Guinea, Australien (Queensland), Norfolk-Insel, Neu-Kaledonien, Fidshi Inseln, Samoa, Tahiti.

Lopholejeunea falcifolia Steph. in sched. = *Lopholejeunea Knightii* Steph.

Lopholejeunea fimbriata Schffn. 1890, Forschungsreise Gazelle IV:28 = *Lopholejeunea eulopha* (Tayl.) Spr.

18. **Lopholejeunea Finschiana** Steph. 1896, Hedwigia 35:109; 1912, Spec. Hepat. V:83. Wahrscheinlich eine gute, vielleicht endemische Art, welche durch die Lobuli (die aber am Originalmaterial nicht so gut entwickelt sind), durch grosse, runde, ganzrandige, das Perianthium völlig bedeckende Amphigastrien inv. ♀, sowie durch ein kleines rundes Perianthium mit grob gestachelten carinae ausreichend charakterisiert sein dürfte. Die ♀ Involucralbl. sind deutlich gezähnt und laterad gerichtet. Marshall Inseln.

Lopholejeunea gibbosa (Aongstr. 1872 nec 1873) Steph. 1897, Bull. Herb. Boiss. V:842 = *Lopholejeunea subnuda* (Mitt.) Steph. Nach EVANS 1900, Transact. Conn. Ac. X:414; cf. auch sub *Phragmicoma gibbosa* Aongstr.

Lopholejeunea grossealata Steph. 1912, Spec. Hepat. V:95 = *Lopholejeunea Knightii* Steph.

Lopholejeunea hawaica Steph. 1912, Spec. Hepat V:87 = *Lopholejeunea subnuda* (Mitt.) Steph.

19. **Lopholejeunea hispidissima** Steph. 1912, Spec. Hepat. V:80. Diese schöne endemische Art ist durch Lobi und Lobuli inv. ♀, welche in einer stachelartigen Spitze enden, und durch die grossen in zahlreichen lilienartigen Lappen auslaufenden Kiele des Perianthium charakterisiert. Neu-Kaledonien.

Lopholejeunea ? immersa (Mitt.) Steph. 1912, Spec. Hepat. V : 94 = *Lopholejeunea eulopha* (Tayl.) Spr.

Lopholejeunea javanica (Nees) Steph. 1890, Hedwigia 29:16; 1907, Denkschr. Ak. Wiss. Wien 81:99. STEPHANI's Angabe beruht auf einem Irrtum, da *Lopholej. javanica*, übrigens eine zweifelhafte Art, auf die engere Indomalaya beschränkt ist.

Lopholejeunea kermadacensis Steph. in sched. = *Lopholejeunea plicatiscypha* (Hk. f. et Tayl.) Steph.

20. **Lopholejeunea Knightii** Steph. 1896, Hedwigia 35 : 110; 1912, Spec. Hepat. V : 95. Hierher gehört jedenfalls *L. grossealata*. Ich halte es ausserdem für sehr wahrscheinlich, dass *L. Knightii* keine eigene Art ist, sondern zu *L. plicatiscypha* gehört. Nur nach dem Studium der Typen, kann ich darüber nicht mit Sicherheit entscheiden. Ich glaube jedoch, dass die Unterschiede, welche ich zwischen den beiden Sippen angeben kann: kleine Unterschiede in der Insertion der Amphigastrien, in der Form der Lobuli, grob gezähnte Perianthkiele bei *L. Knightii* und kleinere weniger gezähnte Kiele bei *L. plicatiscypha*, keine spezifische Trennung rechtfertigen. Ost-Australien.

Lopholejeunea laceriloba Steph. 1923, Spec. Hepat. VI : 379 = *Lopholejeunea eulopha* (Tayl.) Spr.

Lopholejeunea ? Mannii (Aust.) Steph. 1897, Bull. Herb. Boiss. V:842; 1912, Spec. Hepat. V:94 = *Lopholejeunea subnuda* (Mitt.) Steph.

21. **Lopholejeunea muensis** Steph. 1896, Hedwigia 35 : 110; 1912, Spec. Hepat. V:93. Das Originalmaterial stammt von dem Berge Mou und wurde von BALANSA gesammelt. GOTTSCHKE hat die Art schon (in M. S.) unterschieden. Einige andere *Lopholejeuneen*, welche in STEPHANI's Herbar als *L. muensis* liegen, gehören nicht hierher. Nahe verwandt ist *L. latilobula* Verd. aus Neu-Guinea, welche jedoch anders gestaltete Lobuli, breitere Amphigastrien, grosse, immer gut entwickelte, zugespitzte Lobuli inv. ♀ hat. Das Amphigastrium intimum inv. beider Arten ist gezähnt. *L. Colensoi* ist durch die ganz anders verlaufende margo postica der Lobuli und besonders durch das Perianthium gleich zu unterscheiden. Neu-Kaledonien.

22. **Lopholejeunea multiflora** Jack und Steph. 1894, Bot. Centralbl. 60: Sep. p. 9; Steph. 1912, Spec. Hepat. V:79. Soweit ich aus dem dürftigen und schlecht erhaltenen Originalmaterial schliessen kann, eine gute Art, charakterisiert durch manchmal (aber nicht immer) zugespitzte Lobi und besonders durch das Perianthum, länglich umgekehrt birn-

förmig mit mächtig entwickelten aber nur im oberen Teil vorhandenen Cristae. Amphig. inv. ♀ int. ganzrandig, klein; Lobuli kaum entwickelt; Lobi etwas gezähnt, nicht zugespitzt. Bemerkenswert sind die kleinblättrigen Aeste mit sehr grossen, gut entwickelten Lobuli und dreieckig zugespitzte Lobi. **Fidschi Inseln.**

23. **Lopholejeunea norfolkiensis** Steph. 1889, Hedwigia 28; 1912, Spec. Hepat. V:96. Ich konnte nur einige schlecht entwickelte Aeste untersuchen, halte es aber kaum für wahrscheinlich, dass eine von *L. eulopha* zu trennende Art vorliegt. **Norfolk Inseln.**

Lopholejeunea Novae Guinea Steph. 1912, Spec. Hepat. V:90, welche auch für Tahiti angegeben wird, gehört (cf. Nova Guinea, Bot., vol. XIV) zu *Lopholejeunea eulopha* (Tayl.) Spr.

Lopholejeunea oceanica (Mitt.) Steph. 1923, Spec. Hepat. VI:378 = *Certatolejeunea* sp. Ich habe das Originalmaterial (leg. POWELL) aus MITTEN'S Herbar untersucht. Uebrigens kann man aus der Original-Diagnose schon schliessen, dass es sich um eine *Ceratolejeunea* handelt. In den Icones von STEPHANI ist nicht MITTEN'S Original abgebildet, doch wird dies wohl als Original von *Lopholejeunea oceanica* Steph. zitiert. (Cf. MITTEN 1871 Fl. vitiensis p. 414).

Lopholejeunea owahuensis Steph. 1896, Hedwigia 35:11 = *Lopholejeunea subnuda* (Mitt.) Steph.

24. **Lopholejeunea parva** Steph. (nec. Schffn.) 1907, Denkschr. Ak. Wiss. Wien. 81:295; 1912, Spec. Hepat. V:90. Dass das Autorenzitat „Schffn“ in den Species Hepaticarum auf ein Irrtum beruht, habe ich in de Frull. XII, Ann. Bryol. VII:80 schon angegeben. Die Pflanze von Samoa ist, besonders was die ♀ Infl. anbelangt, der malayischen *L. horticola* Schffn. nicht unähnlich, unterscheidet sich aber durch den monözischen Blütenstand und kleinere anders geformte Lobuli. **Samoa.**

25. **Lopholejeunea plicatiscypa** (Hook. f. et Tayl.) Steph. 1912, Spec. Hepat. V:96. Von den von STEPHANI angeführten Synonymen gehören nur die ersten zwei hierher. **Ost-Australien, Neu Seeland, Kermadec Inseln.**

26. **Lopholejeunea proxima** Steph. 1912, Spec. Hepat. V:89. Das Originalmaterial, welches auch in den Ic. Ined. abgebildet ist, unterscheidet sich nicht so stark von *L. subnuda*, dass man bei erster Untersuchung gleich von der Notwendigkeit einer spezifischen Trennung überzeugt wird. Glücklicherweise fand ich jedoch unter anderen von FAURIE bei Kalung gesammelten Lebermoosen (FAURIE n. 35) Material, das mit Sicherheit lehrt, dass auf Hawaii ausser der seit alten Zeit bekannten

L. subnuda noch eine Art vorkommt. Diese unterscheidet sich durch einen etwas länglicheren Lobulus, durch meistens ziemlich deutlich zugespitzte Lobi (welche an anderen Pfl. auch abgerundet sein können), durch den deutlichen Lobulus im ♀ Involuerum, durch deutlich gezähnte ♀ Involucrallbl., durch meistens gezähnte Amphigastrien (runder und grösser als bei *L. subnuda*) und durch ein etwas kürzeres mit reichlich gezähnten Kielen versehenes Perianth. H a w a i i (Kauai).

Lopholejeunea pterocalyx Steph. in sched. = *Lopholejeunea Knightii* Steph.

Lopholejeunea pyriflora Steph. 1912, Spec. Hepat. V : 88; Verd. 1932, de Frull. XII : 83 = *Lopholejeunea subfusca*. Ich konnte nun auch das Original untersuchen.

27. **Lopholejeunea Reineckeana** Steph. 1912, Spec. Hepat. V : 78. Eine schöne Art. Das Perianthium erinnert etwas an *L. multiflora*, aber vegetativ stimmt *L. Reineckeana* z.B. viel mehr mit *L. applanata* überein. Durch das riesige Perianth mit den grossen tief zerschlitzten Cristae leicht von den Verwandten zu unterscheiden. *L. Reineckeana* zeigt einen langen gut entwickelten Hauptstamm mit kurzen Seitenästen an den Enden. S a m o a.

Lopholejeunea ? renistipula (Mitt.) Steph. 1912 Spec. Hepat. V : 94. MITTEN's Original war nicht aufzufinden.

Lopholejeunea Sagraeana (Mont.) Spr. Diese Art, welche früher manchmal mit *L. subfusca* verwechselt wurde, kommt nicht in Asien oder Ozeanien vor. In THÉRIOT's Neu-Kaledonienexsiccaten ist aber sub no. 121 *L. Sagraeana* (det. STEPHANI) herausgegeben. Ich habe in mehreren Herbarien no. 121 des betreffenden Exiccates untersucht, finde aber immer ein Gemisch von Schizostipae, Laubmoosen und *Lopholej. eulopha*.

28. **Lopholejeunea subfusca** (Nees) Steph. 1890, Hedwigia 29 : 16. Cf. de Frull. XV. Vorderindien, Ceylon, Sumatra, P. Penang, Java, Mal. Halbinsel, Borneo, Philippinen, Banda, Ambon, Neu-Guinea, Neu-Kaledonien, Samoa, Tahiti.

29. **Lopholejeunea subnuda** (Mitt.) Steph. 1897, Bull. Herb. Boiss. V : 842; Evans 1900, Transact. Conn. Acad. X : 414. H a w a i i.

Lopholejeunea tecta (Mitt.) Steph. 1912 Spec. Hepat. V : 85 = *Lopholejeunea plicatiscypha* (Hk. f. et Tayl.) Steph. Das Originalmaterial stammt von den Kermadec Inseln, nicht von den Fidschi Inseln, wie STEPHANI l. c. angibt.

Lopholejeunea Vescoana Steph. 1923, Spec. Hepat. VI : 379 =

Lopholejeunea eulopha (Tayl.) Spr. Die von mir untersuchten Teile des Originals von *L. Vescoana* waren steril, es ist daher nicht unmöglich, dass die ♀ Infl. nicht mit denen von *L. eulopha* übereinstimmen, doch ist dies nicht wahrscheinlich.

30. **Lopholejeunea yapensis** Steph. 1912, Spec. Hepat. V:81. Diese Art gehört in den Formenkreis von *L. subfusca*. Möglicherweise handelt es sich um eine lokal konstante Form, wie man dies bei *Lopholej. subfusca* öfters beobachten kann. Charakteristisch wären dann die grossen breit zungenförmigen Lobuli (die aber am Originalmaterial nicht immer so aussehen, wie STEPHANI sie abbildete) und das vollkommen ganzrandige Involuerum. K a r o l i n e n (Yap.).

Marchesia bacciferum Trev. 1877, Mem. Ist. Lomb. III, IV:405 = *Symbyezidium bacciferum* (Tayl.) Steph.

31. **Marchesia Mittenii** Evs. 1900, Transact. Conn. Ac. X:422. — H a w a i i.

Mastigolejeunea apiculata Steph. 1897, in Besch., J. de Botan. XII. Sep. p. 6 = wahrscheinlich *Brachiolejeunea apiculata* Steph. = *Thysananthus polymorphus*.

Mastigolejeunea appendiculifolia Steph. 1912, Spec. Hepat. IV:773 = *Mastigolejeunea humilis* (Gottsche) Spr.

Mastigolejeunea auriculata (Wils. et Hk.) Schffn. cf. sub *Phragmicoma versicolor* L. et L.

Mastigolejeunea badia Steph. 1912, Spec. Hepat. IV:779. Diese Pflanze stammt von Vanicoro und wurde von BECHERELLE an GOTTSCHKE geschickt. In den Ic. Ined. ist sie als „*Acrolej. badia* (Gottsche) St.“ bezeichnet. Es handelt sich entweder um eine robuste *Mastigolejeunea* oder um eine *Ptychocoleus*. Das Original ist aber weder in Paris noch in Berlin vorhanden.

32. **Mastigolejeunea calcarata** (Mitt.) comb. nov. Lobi deutlich oder breitreieckig zugespitzt, Lobuli laufen in eine längliche Spitze aus (wie auf Java bei montanen Formen von *M. humilis*). Durch die Lobi, deren Spitzen und Marginae anticae manchmal völlig eingerollt sind, von *M. humilis* zu unterscheiden. Die Pflanze, welche vom Bureau of Science in Manila sub no. 10498 als „*Mastigolej. spiniloba* St. n. sp.“ distribuiert worden sind, gehören zu *M. humilis* und stimmen mit *M. spiniloba* nur in der Gestalt der Lobuli überein. F i d s c h i I n s e l n.

33. **Mastigolejeunea Frauenfeldii** (Reich.) Steph. 1890, Hedwigia 29:139. Steht der *M. atypus* sehr nahe. Diese ist aber doppelt so gross, die Lobi haben ein deutliches rundes freies Appendiculum anticum, das

bei *M. gibbosa* fehlt oder jedenfalls nur undeutlich ausgebildet ist. Die Lobuli von *M. gibbosa* sind flach und laufen in einer geraden Spitze aus, während die Lobuli von *M. atypus* stumpf sind und mit dem teilweise eingerollten postikalen Lobusrand eine grössere Auricula bilden. Die verwandte *M. spiniloba* ist grösser, hat ganz andere Lobi etc. Die viel kleinere *M. ligulata* hat andere Lobuli, Amphigastrien etc., ist aber näher verwandt. Von allen genannten Arten ist *M. Frauenfeldii* dann noch wesentlich verschieden durch die grosse Anzahl von accezorischen Kielen auf dem Perianthium. Es ist interessant, wie sehr die Formen der ♀ Infl. der Gattung *Mastigolejeunea* wechseln können, während bei den meisten Arten aus einer Gattung die Blätter und Amphigastrien des ♀ Invol. nur geringe Unterschiede aufweisen. Tahiti.

Mastigolejeunea guahamensis (Lindenb.) Steph. 1912. Spec. Hepat. IV:769 = *Mastigolejeunea humilis* (Gottsche) Spr.

Mastigolejeunea honoluluana Steph. 1924, Spec. Hepat. VI:562 = *Lopholejeunea subnuda* (Mitt.) Steph.

34. ***Mastigolejeunea humilis*** (Gottsche) Spr. 1884. Hepat. Amaz. et Andin. p. 101. Cf. de Frull. XV. Annam, Andamanen, Ceylon, Sumatra, Java, Banda, Mal. Halbinsel, Philippinen, Celebes, Ambon, Neu-Guinea, Mioko, Marianen, Neu-Pommern, Neu-Kaledonien, Fidschi Inseln, Samoa, Tahiti.

35. ***Mastigolejeunea integrifolius*** (Steph.) Verd. comb. nov. Diese höchst merkwürdige Pflanze hat mit *Thysananthus* nichts zu tun, jedoch ist ihre genaue Stellung zweifelhaft. Die Blätter sind nämlich typische *Ptychocoleus*- oder *Brachiolejeunea*-Blätter, dagegen die Stellung der ♀ Infl., das ♀ Inv. und Perianthium ganz typisch nach dem *Mastigolejeunea*-Plan. Einigermassen verwandte Arten kenne ich nicht. Possession Island (Torres Street).

Mastigolejeunea ligulata (Lehm. und Lindenb.) Spr. 1884, Hepat. Amaz. et Andin. pag. 101. Kommt, so weit ich feststellen kann, im Gebiet nicht vor. Die Angaben von MITTEN und STEPHANI beziehen sich auf andere Arten.

Mastigolejeunea Novae Zelandiae Steph. 1912, Spec. Hepat. IV:779 = *Archilejeunea scutellata* (Hk. f. et Tayl.) Steph.

Mastigolejeunea novohibernica Schffn. 1890, Forschungsreise Gazelle IV:23. Diese Art, welche zu *Mastigolej. ligulata* (Lehm. and Lindenb.) Spr. gehört, wird von STEPHANI (Spec. Hepat. IV:770) für Tahiti angeführt. Diese Angabe bezieht sich aber auf *Mastigolej. Frauenfeldii* (Reich.) Steph.

36. **Mastigolejeunea Pancheri** (Gottsche msc.) Steph. 1912, Spec. Hepat. IV:771. Da die Pflanze steril ist, ist die Gattungsbezeichnung unter Umstände nicht richtig, dies halte ich jedoch kaum für wahrscheinlich, jedenfalls handelt es sich um eine vorzüglich charakterisierte und allem Anscheine nach endemische Art. Von *A. samoana* (= *A. caramuensis*), *M. atypus* und anderen Arten leicht zu unterscheiden durch Grösse und Habitus, durch Gestalt und Faltung der Lobi, durch Form und Grösse der Amphigastrien. Neu-Kaledonien.

37. **Mastigolejeunea phaea** (Gottsche msc.) Steph. 1889, Hedwigia 28; 1912, Spec. Hepat. IV:780. Durch auffallende Breite, zugespitzte Lobi, eingerollte in einer Spitze auslaufende Lobuli und das nicht völlig ganzrandige Involucrum charakterisiert. Australien (nicht im Nord Osten).

Mastigolejeunea recurvistipula Steph. 1912, Spec. Hepat. IV:781 = *Mastigolejeunea phaea* (Gottsche msc.) Steph.

Mastigolejeunea sandvicensis Steph. 1889, Hedwigia 28:29 = *Brachiolejeunea sandvicensis* (Gottsche) Steph.

Mastigolejeunea spiniloba Steph. 1912, Spec. Hepat. IV:775 = *Mastigolejeunea calcarata* (Mitt.) Verd.

Mastigolejeunea taitica (Gottsche msc.) Steph. 1896, Hedwigia 35:112; 1912, Spec. Hepat. IV:775 = *Mastigolejeunea humilis* (Gottsche) Spr., auch die zahlreichen anderen Pflanzen, welche in STEPHANI's Herbar als *M. tahitica* liegen, gehören hierher.

38. **Mastigolejeunea vanicorensis** (Steph.) Verd. comb. nov. Durch die zugespitzten Lobi, die Gestalt der Lobuli und die länglichen, tiefer gefalteten Perianthien von den robusten Formen von *M. humilis* zu unterscheiden. Vanicoro.

Mastigolejeunea virens (Aongstr.) Steph. 1912, Spec. Hepat. IV:776 *Mastigolejeunea humilis* (Gottsche) Spr.

Mastigolejeunea Volkensii Steph. 1912, Spec. Hepat. IV:777 = *Hygrolejeunea* sp. (Cf. de Frull. XV).

Mastigolejeunea Wattsiana Steph. 1912, Spec. Hepat. IV:780 = *Mastigolejeunea phaea* (Gottsche msc.) Steph.

Odontolejeunea ? contractilis (Mitt.) Steph. 1912, Spec. Hepat. V:182 = *Caudalejeunea renistipula* (Gottsche) Steph.

Phragmicoma aulocophora Mont. 1843, Ann. Sc. Nat. Bot. 19:259; Mitt. 1871, Fl. vitiensis p. 412 = *Ptychocoleus aulacophorus* (Mt.) St.

Phragmicoma baccifera Tayl. 1846, L. Journ. of Bot. V:387 = *Symbyezidium bacciferum* (Tayl.) Steph.

Phragmicoma bicolor Mont. (nec. Nees) 1846, Voyage Bonité, pag. 223 = *Brachiolejeunea sandvicensis* (Gottsche) Evs.

Phragmicoma bilabiata Mitt. 1871, Fl. vitiensis p. 412. Das Originalmaterial ist nirgends aufzufinden.

Phragmicoma calcarata Mitt. 1871, Fl. vitiensis p. 413 = *Mastigolejeunea calcarata* (Mitt.) comb. nov.

Phragmicoma contractilis Mitt. 1871, Flora vitiensis p. 412 = *Caudalejeunea renistipula* (Gottsche) Steph.

Phragmicoma renistipula Mitt. 1871, Fl. vitiensis p. 412 gehört zu *Mastigolejeunea humilis*, nicht zu *Harpalejeunea*, wie STEPHANI 1913, Spec. Hepat. V:267 angibt. Die Originale stammen vom Isle of Pines (Miln, Strange) und von den „Pacific Islands“ (Beecher).

Phragmicoma Eavesiana Gottsche in Müll., 1880, Fragm. Phytog. Austr. XI:63 = *Archilejeunea scutellata* (Hk. f. et Tayl.) Steph.

Phragmicoma gibbosa Aongstr. 1873, Oefv. K. Vet. Ak. Förh. 1873, no. 5, pag. 133 (nec 1872, pag. 23!) = *Mastigolejeunea Frauenfeldii* (Reich.) St. Man achte darauf, dass *Lejeunea gibbosa* Aongstr. und *Phragmicoma gibbosa* Aongstr. nichts mit einander zu tun haben. STEPHANI 1898 (in Besch., J. de Bot. XII, Sep. p. 4) hat beide zusammen gezogen!

Phragmicoma eulopha (Tayl.) Mitt. 1871, Fl. vitiensis p. 413 = *Lopholejeunea eulopha* (Tayl.) Spr.

Phragmicoma immersa Mitt. 1871, Fl. vitiensis p. 412 = *Lopholejeunea eulopha* (Tayl.) Spr.

Phragmicoma ligulata (L. et L.) Mitt., 1871, Fl. vit. p. 412 = *Mastigolejeunea ligulata* (L. et L.) Spr.

Phragmicoma Mannii Aust. 1874, Bull. Torrey Bot. Club V:15 = *Lopholejeunea subnuda* (Mitt.) Steph.

Phragmicoma olivacea (Hook. f. et Tayl.) Mitt. 1855, Fl. Nov. Zel. p. 157; 1871, Fl. vitiensis p. 412; Hook. f. 1864—67, Handb. p. 532 = *Archilejeunea olivacea* (Hk. f. et Tayl.) Steph.

Phragmicoma Pancheri Gottsche in sched. = *Mastigolejeunea Pancheri* Steph.

Phragmicoma pallida Aongstr. 1873, Oefv. Kgl. Sv. Vet. Ak. Förh. 1873, no. 5, p. 132 = *Ptychocoleus pallidus* Steph.

Phragmicoma plana (Sde Lac.) Mitt. 1871, Fl. vitiensis, p. 412 = *Thysananthus planus* Sde Lac.

Phragmicoma plicatiscypha Hook. f. et Tayl. 1846, L. Journ. of Bot. III:386 = *Lopholejeunea plicatiscypha* (Hk. f. et Tayl.). Mit

Thysananthus anguiformis (cf. Hooker f., Handb. p. 533) hat diese Pflanze nichts zu tun.

Phragmicoma renistipula Mitt. 1871, Fl. vitiensis p. 413. Cf. sub *Lopholejeunea*.

Phragmicoma polyantha Jack in sched. = (nach Steph. in ic. ined.) *Mastigolejeunea taitica* (G. msc.) St. = *M. humilis* (Gottsche) Spr.

Phragmicoma sandvicensis (Gottsche 1857, Ann. Sc. Nat. IV, VIII:344 = *Brachiolejeunea sandvicensis* (Gottsche) Evs.

Phragmicoma securifolia (Endl.) Nees 1845, Syn. Hepat. p. 300 = *Ptychocoleus securifolius* (Endl.) Steph.

Phragmicoma taitica (Gottsche in sched. et in icon. = *Mastigolejeunea humilis* (Gottsche) Spr.

Phragmicoma subnuda Mitt. 1871, Fl. vitiensis p. 412 = *Lopholejeunea subnuda* (Mitt.) Steph.

Phragmicoma subsquarrosa Aust. 1869, Proc. Ac. Nat. Sci. Phil. for 1869, p. 225 = *Brachiolejeunea sandvicensis* (Gottsche) Evs.

Phragmicoma tecta Mitt. 1871, Flora vitiensis p. 412 = *Lopholejeunea plicatiscypha* (Hk. f. et Tayl.) Steph.

Phragmicoma Thozetiana Gottsche et Müller 1880, Fragm. Phyt. Austr. XI:63 = *Brachiolejeunea Thozetiana* (G. et M.) Steph.

Phragmicoma tumida (Nees) Mitt. 1871, Fl. vitiensis p. 412 = *Ptychocoleus tumidus* (Nees) Trev.

Phragmicoma versicolor Lehm. et Lindenb. Diese Pflanze, welche zu der neotropischen *Mastigolejeunea auriculata* gehört, wird von MONTAGNE (1848, Ann. Sc. Nat. Bot. 3, 10:112) und von REICHARDT (1870, Reise der Novara, p. 155) für Tahiti angeführt. Es handelt sich zweifellos um die auf Tahiti sehr häufige *M. humilis*.

Platylejeunea baccifera Steph. 1890, Hedwigia 29:6 = *Symbyezidium bacciferum* (Tayl.) Steph.

Platylejeunea cryptocarpa (Mitt.) Steph. 1897, Bull. Herb. Boiss. V:842.

Platylejeunea samoana Steph. 1907, Denkschr. Ak. Wiss. Wien 81:297 = *Symbyezidium samoanum*.

Ptychanthus Brotheri Steph. 1912, Spec. Hepat. IV:751 = *Ptychanthus striatus* (Lehm. und Lindenb.) Nees.

Ptychanthus mollis Hook f. et Tayl., 1846 L. Journ. of Bot. III:384 = *Ptychocoleus mollis* (Hk. f. et Tayl.) Steph.

Ptychanthus rhombifolius Steph. in sched. = *Ptychanthus striatus* (L. et L.) Nees.

Ptychanthus samoanus Steph. in sched. = *Ptychanthus striatus* (L. et L.) Nees.

Ptychanthus Stephensonianus (Mitt.) Steph. 1912, Spec. Hepat. IV:754 = *Ptych. striatus* var. *intermedius* (Gottsche). Cf. de Frull. XV.

39. **Ptychanthus striatus** (L. et L.) Nees 1838, Naturgesch. Eur. Leberm. III:212. Cf. de Frull. XV. Centralafrika, Südafrika, Madagascar, Japan, China, Himalaya, Birma, Siam, Vorderindien, Ceylon, Andamanen, Sumatra, Java, Mal. Halbinsel, Borneo, Philippinen, Celebes, Halmaheira, Ambon, Neu-Guinea, Neue Hebriden, Samoa, Australien, Neu-Seeland.

40. **Ptychocoleus aulacophorus** (Mont.) Steph. 1912, Spec. Hepat. V:38. Cf. de Frull. XV. Philippinen, Neu-Guinea, Manga Reva, Salomon-Inseln, Samoa.

Ptychocoleus brunneus Steph. 1912, Spec. Hepat. V:38 = *Ptychocoleus pycnocladus* (Tayl.) Steph.

41. **Ptychocoleus caledonicus** Steph. 1912, Spec. Hepat. V:39. Stimmt in Grösse und Form der Amphigastrien mit *Ptychoe. aulacophorus* überein. Lobuli aber wie bei einem zarten *P. fertilis*, mit 2—4 schwach entwickelten Zähnen versehen. Lobulus nur wenig kleiner als der Lobus, hoch mit diesem verwachsen. Viel lässt sich über diese Art nicht sagen, da das zu Verfügung stehende Material zu spärlich ist. Die Pflanze wurde in Thériot's Musci et Hep. Nov. Caled. Exisec. sub no. 116 herausgegeben. Meistens findet man in dieser no. nur musci. Neu-Kaledonien.

42. **Ptychocoleus Cumingianus** (Mont.) Trevis. 1877, Mem. Ist. Lomb. III, IV:405. Cf. de Frull. XV. Nikobaren, Andamanen, Sumatra, Java, Mal. Halbinsel, Borneo, Philippinen, Celebes, Ambon, Ceram, Neu-Guinea, Karolinen, Australien (Queensland), Samoa, Tahiti, Marquesas Inseln.

43. **Ptychocoleus fertilis**. (Rw. Bl. N.) Trev. 1877, Mem. Ist. Lomb. III, IV:405. Cf. de Frull. XV. Nikobaren, Sumatra, Penang, Mal. Halbinsel, P. Weh, Java, Philippinen, Neu-Guinea, Tahiti.

44. **Ptychocoleus Hasskarlianus** (Gottsche) Steph. 1912, Spec. Hepat. V:44. Cf. de Frull. XV. Sumatra, Java, Borneo, Ambon, Bougainville, Samoa, Tahiti.

45. **Ptychocoleus laxus** Steph. 1912, Spec. Hepat. V:46. Das

spärliche Originalmaterial macht deutlich den Eindruck, dass es unter abnormen, sehr feuchten Bedingungen aufgewachsen ist. Man kann nicht entscheiden, ob es sich um eine abnorme hyrophile laxa Modifikation handelt, oder ob eine eigene endemische Art vorliegt. Neu-Kaledonien.

Ptychocoleus marquesianus (Steph.) Steph. 1912, Spec. Hepat. V:48 = *Ptychoe. Cumingianus* (Mt.) Trevis. Im Herbar STEPHANI liegt aber auch *P. Hasskarlianus* (von Tahiti) unter dem Namen *Ptychoc. marquesianus*.

46. **Ptychocoleus mollis** (Hook. f. et Tayl.) Steph. 1912, Spec. Hepat. V:59. Wird vermutlich identisch sein mit *P. securifolius* (Endl.) Steph., doch lässt sich darüber, solange das Originalmaterial nicht aufgefunden ist, nichts mit Bestimmtheit sagen. Jedenfalls hat die Art mit *Thysananthus* (womit MITTEN, Fl. New Zeal., p. 156—157 und HOOKER f., Handb. p. 532 sie vergleichen wollten) nichts zu tun. Es kann sich nur um eine *Ptychocoleus* handeln. Neu-Seeland, Bay of Islands (J. D. Hooker).

Ptychocoleus Novae Guineae (Steph.) Steph. 1912, Spec. Hepat. V:49. Das Original von Neu-Guinea gehört zu *Ptychocoleus Cumingianus*. Die zahlreichen Samoa-Pflanzen welche STEPHANI hierher stellte, gehören meistens zu *P. Hasskarlianus* oder sind Zwischenformen zwischen *P. Hasskarlianus* und *P. Cumingianus*, welche auf Samoa, wie in West-Java, sehr häufig sind.

Ptychocoleus papulosus Steph. 1912, Spec. Hepat. V:50 = *Ptychocoleus aulacophorus* (Mont.) Steph.

Ptychocoleus pallidus (Aongstr.) Steph. 1912, Spec. Hepat. V:50. Diese Art konnte ich nicht untersuchen.

47. **Ptychocoleus parvus** Steph. 1912, Spec. Hepat. V:50 = *Ptychocoleus securifolius* (Endl.) Steph. In STEPHANI's Herbar fehlen Belege für die Angabe „Neu-Guinea“. Selber hat STEPHANI Material, das WATTS 1901 am Richmond Fluss in N.S. Wales sammelte, als Typus bezeichnet (hb. Levier 3011), und dies wird auch in den Icones abgebildet. Es ist nicht gut erhalten, Perianthien sind nicht vorhanden, doch halte ich es für kaum wahrscheinlich, dass es sich um etwas anderes als *P. securifolia* handelt. Australien (N. S. Wales).

48. **Ptychocoleus pycnocladus** (Tayl.) Steph. 1912, Spec. Hepat. V:52. Cf. de Frull. XV. Ceylon, Andamanen, Penang, Sumatra, Mal. Halbinsel, Java, Borneo, Philippinen, Ambon, Neu-Guinea, Salomon Inseln, Samoa, Tahiti.

Ptychocoleus Rechingeri (Steph.) Steph. 1912, Spec. Hepat. V : 52. = *Ptychoc. Hasskarlianus* (Gottsche) Steph.

Ptychocoleus samoanus Steph. 1912, Spec. Hepat. V : 53 = *Ptychocoleus Hasskarlianus* (Gottsche) Steph.

49. **Ptychocoleus securifolius** (Endl.) Steph. 1912, Spec. Hepat. V : 59. — Ostaustralien, Norfolk Insel, Neu-Seeland.

Ptychocoleus setaceus Steph. 1912, Spec. Hepat. V : 54 = *Ptychocoleus Hasskarlianus* (Gottsche) Steph.

Ptychocoleus subinnovans Steph. 1912, Spec. Hepat. V : 56 = *Ptychocoleus pycnocladus* (Tayl.) Steph.

Ptychocoleus tumidus (Nees) Trev. 1877, Mem. Ist. Lomb. III, IV:405. Wurde wahrscheinlich nie in Ozeanien gefunden. Cf. de Frull. XV.

50. **Ptychocoleus Wildii** Steph. 1912, Spec. Hepat. V : 60. So weit ich nach dem Studium des dürftigen Originals beurteilen kann, lässt sich diese Art gut von *P. securifolius* durch den monözischen Blütenstand und den stark distal verlängerten Kiel der Lobi und Lobuli unterscheiden. Australien (Queensland).

Ptycholejeunea elongata Steph. 1900, Transact. Conn. Ac. X : 423 = *Thysananthus polymorphus*.

Pycnolejeunea integristipula Jack und Steph. 1894, Bot. Centralbl. Vol. 60, Heft 4 = *Symbyezidium integristipulum* (J. et St.) Steph. Ich konnte das Original leider nicht bekommen; der Abbildung nach kann es sich kaum um eine andere Art handeln als *S. bacciferum* oder *S. cryptocarpum*.

Stictolejeunea squamata (Willd.) Schffn. Die Angaben „Hawaii“ und „India“ der Synopsis Hepaticarum beruhen entweder auf falschen Standortangaben, die damals nicht selten waren oder (wenigstens was Hawaii anbetrifft) auf einer Verwechslung mit *Symbyezidium*. EVANS 1900 (Transact. Conn. Ac. X) erwähnt die Angabe gar nicht.

51. **Symbyezidium bacciferum** (Tayl.) Steph. 1912, Spec. Hepat. V : 105. Um definitiv über die ozeanischen *Symbyezidium*-Arten urteilen zu können, wäre ein eingehendes Studium der neotropischen Arten und ihrer Variabilität notwendig. In neueren Kollektionen fehlt *Symbyezidium* fast immer. Was ich gesehen habe, macht einen so heterogenen Eindruck, dass ich unmöglich sagen kann, ob es sich um eine oder um mehrere Arten handelt. EVANS 1900 (Transact. Conn. Acad. X:417—418) trennt *S. cryptocarpum* und *S. bacciferum*, ob dies richtig ist, weiss ich nicht. Das typische *S. cryptocarpum* hat tief inserierte ziemlich grosse Amphi-

gastrien, welche $1\frac{1}{2}$ mal so breit sind als lang; es wurde in A u s t r a l i e n und in H a w a i i gesammelt. Das typische *S. cryptocarpum*, wovon ich aus MITTEN's Herbar das Original und andere von MITTEN hierher gestellte Exx. untersuchen konnte, hat runde, flach inserierte, kleine Amphigastrien; es wurde auf H a w a i i, den Fidschi Inseln und Isle of Pines gesammelt.

52. **Symbyezidium cryptocarpum** (Mitt.) Steph. 1912, Spec. Hepat. V:107. Cf. sub *S. bacciferum*.

Symbyezidium integristipulum (Jack und Steph.) Steph. 1912, Spec. Hepat. V:106. Cf. sub *Pycnolejeunea*.

53. **Symbyezidium samoanum** (Steph.) Steph. 1912, Spec. Hepat. V:106 unterscheidet sich von *S. bacciferum* durch die in eine gekrümmte freie Spitze auslaufenden Lobuli, durch runde, viel kleinere Amphigastrien, welche auch basal nicht so weit am Stamm herablaufen, wie dies bei *S. bacciferum* der Fall ist. Hierher gehört auch *S. cryptocarpum*, welche MITTEN 1871 (Fl. vit. p. 413) für Samoa (leg. POWELL) anführt. S a m o a.

Thysanolejeunea plana Steph. 1889, Hedwigia 28:263 = *Thysananthus planus* Sde Lac.

Thysananthus abietinus (Spr. ms.) Steph. 1912, Spec. Hepat. V:794 = *Thysananthus fruticosus* (Lindenb. et L.) Schffn.

54. **Thysananthus anguiformis** Hk. f. et Tayl. 1844, L. Journ. of Bot. III:567; Syn. Hepat. 1845, pag. 289; Steph. 1912, Spec. Hepat. IV:800. Steht *Thysananthus convolutus* wohl am nächsten, unterscheidet sich aber in vieler Hinsicht. Die Lobi sind zwar prinzipiell nach demselben Plan gebaut, aber an sterilen Stammteilen weniger und in den ♀ Infl. meistens gar nicht gezähnt. Dann sind die Lobuli proximal abgerundet und tragen eine deutliche, aus mehrere Zellen bestehende Spitze. ♀ Infl. klein, meistens mit nur einer Innovation. Man achte darauf, dass MITTEN und STEPHANI *Thys. anguiformis*, *Ptychocoleus mollis* und *Lopholejeunea plicatiscypha* mit einander verwechselt haben. Die Synonymenlisten STEPHANI's für diese Arten sind ganz falsch; komisch wirkt STEPHANI's Bemerkung in Spec. Hepat. IV:800 (1912). A u s t r a l i e n (Great Barrier Isl.), Neu-Seeland.

Thysananthus appendiculatus Steph. 1912, Spec. Hepat. IV:794. Diese durch die eigentümlichen Appendicula am postikalen Lobusrande recht abweichende Art ist vermutlich auf Neu Guinea beschränkt. Das Material von der Norfolk Insel (das STEPHANI hierher stellte) gehört zu *Thys. fruticosus*.

Thysananthus Bowianus Steph. in sched. et in ic. ined. = *Thysananthus fruticosus* (Lindenb. et G.) Schff.

Thysananthus elongatus (Aust.) Evs. 1900, Transact. Conn. Ac. X:423 = *Thysananthus polymorphus* Sde Lac.. In de Frullan. VIII habe ich *Frull. sandvicensis* nicht eingezogen, da es sich um eine typische lokale (lokal auch ziemlich konstante) Facies vom *Frull. squarrosa* handelte. Aus denselben Gründen könnte man *Thys. elongatus* aufrecht halten, sie ist jedoch weder auf Hawaii beschränkt, noch tritt sie in einer konstanten Form auf. Als einziges Unterscheidungsmerkmal ist anzuführen, dass die üppig entwickelten breiten Formen von *Thys. polymorphus* aus dem javanischen Urwalde nicht in Ozeanien gefunden wurden. Sonst stimmen beide Sippen in ihrer charakteristischen Variabilität so weit überein, dass ich sie (auch schon deswegen, weil ein kontinuierliches Areal vorliegt) nicht trennen kann.

Thysananthus Frauenfeldii Reich. 1870, Reise der Novara, pag. 155 = *Mastigolejeunea Frauenfeldii* (Reich.) Steph.

55. **Thysananthus fruticosus** (Lindenb. et S.) Schffn. 1893, Nat. Pflanzenf. 1, III:130. Cf. de Frull. XV. Sumatra, Java, Banda, Mal. Halbinsel, Borneo, Philippinen, Celebes, Ceram, Neu Guinea, Neu Hannover, Neu Mecklenburg, Neue Hebriden, Australien (Queensland), Norfolk Insel, Neu Kaledonien, Fidschi Inseln, Samoa.

56. **Thysananthus Gottschei** (Jack. et Steph.) Steph. 1912, Spec. Hepat. IV:787. Cf. de Frull. XV. Andamanen, Sumatra, Borneo, Philippinen, Neu Guinea, Neu Irland.

Thysananthus hebridensis Steph. 1924, Spec. Hepat. VI:565 = *Thys. spathulistipus* (R. Bl. N.) Lindenb.

Thysananthus integrifolius Steph. 1912, Spec. Hepat. IV:788 = *Mastigolejeunea integrifolia* (Steph.) Verd. comb. nov.

Thysananthus obtusifolius Steph. 1912, Spec. Hepat. IV:792 = *Thysananthus polymorphus* Sde Lac.

Thysananthus ophiocephalus Tayl. 1846, L. Journ. of Bot. V:384 = *Thysananthus anguiformis* Hk. f. et Tayl. Cf. Hooker f. 1864—67, Handb. p. 533 und STEPHANI'S Abbildung von SINCLAIR'S Pflanze (irrtümlich als *A. olivacea* bestimmt) in seinen Icones.

Thysananthus paucidens Steph. 1912, Spec. Hepat. IV:793 = *Thysananthus polymorphus* Sde Lac.

57. **Thysananthus planus** Sde Lac. 1854, Ned. Kruidk. Arch.

III:419. Wurde von MITTEN (1871, Fl. vitiensis p. 412) für Viti angegeben, Belegmaterial sah ich nicht. Pflanzen in Samoa (leg. RECHINGER n. 13), welche in STEPHANI's Herbar als *Caudalej. Stephanii* Spr. liegen, gehören aber zweifellos hierher. Von Sunday Isl. habe ich ebenfalls keine Belegstücke gesehen. Java, Philippinen, Neu-Guinea, Samoa.

58. **Thysananthus polymorphus** Sde Lac. 1856, Nat. Tijdschr. N. O. I. X:396. Cf. de Frull. XV sub *Spruceanthus*. Sumatra, Java, Mal. Halbinsel, Borneo, Philippinen, Celebes, Neu Guinea, Neu Mecklenburg, Neu Kaledonien, Bougainville, Samoa, Tahiti, Hawaii.

Thysananthus rigidus Steph. 1912, Spec. Hepat. IV:790 = *Thysananthus Gottschei* (Jack et Steph.) Steph.

Thysananthus scutellatus Hook. f. et Tayl. 1846, Lond. J. of Bot. III:383 = *Archilejeunea scutellata* (Hk. f. et Tayl.) Steph.

Thysananthus Sinclairii (Mitt.) Steph. 1912, Spec. Hepat. IV:792 = *Thysananthus fruticosus* (Lindenb. et G.) Schffn.

59. **Thysananthus spathulistipus** (Rw., Bl., Nees) Lindenb. 1845, Syn. Hepat. p. 287. Cf. de Frull. XV. Sikkim, Assam, Ceylon, Andamanen, Sumatra, Bangka, Java, Mal. Halbinsel, Borneo, Philippinen, Celebes, Saparoea, Ceram, Neu Guinea, Neu Kaledonien, Neue Hebriden, Samoa.

Thysananthus virens Aongstr. 1873, Oefv. Vet. Ak. Förh. 1873. no. 5, p. 131 = *Mastigolejeunea humilis* (Gottschē) Spr.